SEVENTEENTH ANNUAL REPORT OF THE LOCAL GOVERNMENT BOARD, 1887-88.

SUPPLEMENT

IN CONTINUATION OF THE

REPORT OF THE MEDICAL OFFICER

FOR

1887.

DIARRHŒA AND DIPHTHERIA.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE AND SPOTTISWOODE, East Harding Street, Fleet Street, E.C., and
32, Abingdon Street, Westminster, S.W.; or
ADAM AND CHARLES BLACK, 6, North Bridge, Edinburgh; or
HODGES, FIGGIS, & Co., 104, Grafton Street, Dublin.

1889.

[C.—5638.] *Price* 8*s*.

REPORT AND PAPERS

ON

DIARRHŒA AND DIPHTHERIA.

SUBMITTED BY THE MEDICAL OFFICER OF THE LOCAL GOVERNMENT BOARD.

1888.

REPORT.

TO THE RIGHT HONOURABLE CHARLES THOMSON RITCHIE, M.P., PRESIDENT OF THE LOCAL GOVERNMENT BOARD.

Sir,

As a portion of my report on the proceedings of your Medical Department during 1887, I have the honour to submit to you for presentation to Parliament two important papers, printed in folio for the better exhibition of their tables, diagrams, and charts. Further subjects of 1887 Report.

These papers are, first, a report by Dr. Ballard on the causes of the annual mortality from diarrhœa, which is observed principally in the summer season of the year among English communities; and, secondly, a statistical study, presented to me by Dr. G. B. Longstaff, of the Geographical Distribution of Diphtheria in England and Wales.

Dr. Ballard has, during portions of the last eight years, devoted himself to the most difficult and comprehensive investigation which forms the subject of his present report. Begun originally with the object of understanding the peculiar diarrhœa mortality observed during 1880 in the borough of Leicester, where the death-rate from diarrhœa is habitually high, Dr. Ballard's investigations had soon to be extended over other years and into other places, in order that the conditions determining a special mortality from diarrhœa should be duly apprehended. Dr. Ballard. Diarrhœa.

The need for comprehensive investigation into the nature and causes of diarrhœa is plainly apparent when the rank still held by this disease among the causes of death in England and Wales is considered. For children, it is habitually the most fatal disease of all the so-called "zymotic diseases," not excepting scarlatina, measles, or whooping-cough. For children, indeed, diarrhœa is the most frequently registered cause of death out of all designated causes of death, with the two exceptions of "convulsions" and "bronchitis." In the average of years, its mortality to children under five is as much as one-tenth part of all other causes put together. And this is the position of diarrhœa after years of "sanitary" work in England. Yet, even now, in spite of the encouraging beginnings of study made under the auspices of my predecessor, few sanitary workers are found to give to the disease an amount of thought commensurate with its importance. Sanitary authorities and their advisers, with others who ought to know better, are too commonly content to regard the disease as a cause of death that may or may not be connected with sanitary administration, and to treat the study of diarrhœa as being, therefore, of comparatively little importance.

Drs. Klein and Cash were associated with Dr. Ballard for the purpose of the requisite pathological and chemical studies incidental to the inquiry, and as his inspection progressed, Dr. Ballard had the good fortune to enlist as his fellow-workers a number

A 58158. Wt. 7176.

of skilled observers, official and other, who have supplied him with important material, clinical, statistical, and meteorological.

I have little to say by way of preface to Dr. Ballard's report, since he has himself, in an introductory chapter, given a summary of his investigations and of the results which he is prepared provisionally to announce. To this summary I would at once direct my readers' attention. It will be found that Dr. Ballard has supplied a basis of fact, in place of much that was speculative in our conceptions of so-called "summer diarrhœa"; and from a store of statistical, clinical, and pathological data, that he has formulated a truer and more definite judgment respecting the disease, its nature and causes, than had before been attained.

As to its nature, he indicates that it is no mere local malady of the intestines, showing itself by flux or inflammation; but that it is rather a general constitutional affection proper to be classed among the "acute specific diseases." His observations on the condition of the kidneys in "diarrhœa," are peculiarly worthy of study by medical practitioners, not only by those who have to treat the disease, but also by those who are concerned with the pathology and treatment of the organic diseases of later life.

As regards causation, the evidence brought forward of a continuous though unappreciated presence of the specific disease at other than epidemic seasons and among other than young children, is a most necessary introduction to a due understanding of the personal and local relations of diarrhœa. Following out this evidence, Dr. Ballard's researches go on to dispose of mere heat as a sufficient cause of the disease, and to modify in like manner many current notions about its relations with food and with water; assigning the while, to these and other external conditions—particularly to conditions of soil and atmosphere—more exact places than they had before held in the list of agencies through which a specific material can operate.

Dr. Ballard, having reached this position, would have proposed to himself to go further, and to learn more of what was to be learned respecting diarrhœa in England. Exigencies, however, over which he has no control, forbid, for a time, any considerable expansion of his studies. But I am hoping that he may at least be able, in a subsequent paper, to report more fully on the facts he has already collected, and which are not yet prepared for publication.

Dr. Longstaff.

Diphtheria.

Dr. Longstaff's essay sets forth, as the result of abundant and careful examination of mortality statistics, the facts as to the distribution of fatal diphtheria in the districts of England and Wales during the 26 years ending with 1880; and he shows, in the first place, very notable varieties of incidence of the disease upon the several counties, not explicable by any geographical or geological consideration. He brings into strong relief evidence to show that the disease has always displayed a marked tendency to prevail in sparsely populated districts rather than in centres of population; and that as years have gone on, this tendency has become less and less marked, so that, in later years, the chief urban districts seem to be approaching nearer than before to rural districts in their rate of suffering by this disease. Diphtheria alone among diseases of the zymotic class is found to have exhibited this peculiarity of special incidence upon sparsely peopled districts; and the facts brought together by Dr. Longstaff would certainly seem to suggest that the country has sent, and is increasingly sending, the causes of diphtheria into towns. In this connexion it is impossible not to recall the relations that have occasionally been witnessed between outbreaks of diphtheria and particular milk supplies; and the relations strongly suspected, but not yet sufficiently demonstrated, between diphtheria in man and disease in various domestic animals.

Students of Dr. Longstaff's paper may do well to bear in mind that, in the practice of some medical practitioners, croup and diphtheria are used as convertible terms; and that Dr. Longstaff's essay has reference to those deaths only which are certified to be due to *diphtheria*. Diphtheria is ranked among zymotic diseases by the Registrar-General: croup among local diseases.

I have the honour to be,

Sir,

Your obedient Servant,

December 27, 1888.

GEORGE BUCHANAN.

Dr. Ballard's Report to the Local Government Board upon the Causation of the Annual Mortality from "Diarrhœa" which is observed principally in the Summer Season of the Year.

Causation of "Diarrhœa," by Dr. Ballard.

Introductory.

History of inquiry.

This inquiry was commenced under the Board's instructions at the close of 1880, which had been a year of exceptionally high diarrhœal mortality generally in England and Wales. The death-rate from this cause had only once before been exceeded since the commencement of death registration in 1837, namely, in the year 1868. The high rate of 1880 was accentuated by the circumstance that during the preceding year 1879 the diarrhœal death-rate had been exceptionally small, smaller in fact that in any year since the earliest years of death registration. In London, however, the death-rate of 1880, although much higher than in 1879, had been exceeded in 20 out of the 43 years that had elapsed since 1837, and in many of these 20 years the 1880 death-rate had been greatly exceeded. These events, and some of the considerations thence arising, attracted public attention, and were the immediate occasion of an investigation being set on foot which had for several years been more or less in contemplation. Another point had especially attracted notice; namely, that certain towns, Leicester heading the list of them, had acquired notoriety as specially diarrhœal towns from the almost annual naming of them as such by the Registrar-General in his Quarterly and Annual Reports. Speculations as to the cause there were in abundance, and dogmatic assertions were not wanting, but it was felt that the subject was involved in a darkness which had not yet been pierced. Prior to my being charged with the inquiry, a circular letter had been issued by the Board to the health officers of places in which during the summer of 1880 the mortality had been in excess, requesting the views of these gentlemen as to the cause of the high diarrhœal mortality in their several districts. To this circular a number of replies were returned, many of them suggestive no doubt, but on the whole such as afforded to the Board no information that it did not already possess as representing current medical opinion on the subject in one or another of its phases.

Scope.

The form in which I received my first instructions was to inquire into the cause of the annually recurring high mortality from diarrhœa in Leicester; but it very soon became obvious that the diarrhœa of Leicester did not differ in its nature from that of other places, and that, to interpret it aright, the inquiry would have to be greatly widened and made to embrace not only towns and places resembling Leicester in their high diarrhœal rate but towns and places differing from it in this very particular: and that investigation in this differential sense was requisite, not only in respect of death-rates, but also in respect of the circumstances of locality, character of population, and sanitary advantages or the reverse. Leicester, however carefully looked at, could not be interpreted by itself. The attempt had been made by local observers over and over again, but had failed of any satisfactory result. The scope of the inquiry then was extended, and although Leicester and its misfortune had still to occupy a notable place among the objects of the investigation, it no longer stood as its sole object, but had to rank, first indeed but still to rank, with other high diarrhœal places in England and Wales; for it came to be seen that the reason or reasons why Leicester *and other* places were thus pre-eminent was the actual subject-matter for inquiry. The task became in this way much greater than was originally anticipated; its difficulty was in one sense increased by its extension, in another sense it was lessened, that sense being that it relieved me of much useless and unsatisfactory speculation upon points which could only be determined by the collection and comparison of facts. The inquiry has been prosecuted year by year (though amid manifold and often lengthy interruptions) from 1880 until the present time. I cannot and do not pretend to say that even now the ground has been dug into deeply enough to expose the truth in its entirety, but I hope it will be found that enough has been exposed for sanitary administrators to find some lessons of practical utility, and to indicate to investigators succeeding me directions in which they may best proceed to expose more of the truth. I cannot take too early an opportunity of saying that the sanitary authorities generally of the several towns and districts

Causation of "Diarrhœa," by Dr. Ballard.

included in the inquiry at once afforded me the facilities I required, by supplying me with information such as I could not have otherwise obtained, by placing the services of their officers more or less at my disposal and in some instances by expending money to advance the objects of the inquiry. To many of the Medical Officers of Health and Surveyors of the towns I am under special obligations, not only for their ready co-operation in placing at my disposal stores of already prepared records, but for new labour of considerable amount voluntarily undertaken by them for the furtherance of my study of the subject. I may indeed say, that without such cordial and ample help as I received in this way the inquiry would have proved to be beyond my own ability. Further, during the earlier years of the inquiry I had the very valuable assistance of my colleague Mr. Power, and throughout the inquiry I have had the advantage of his criticism and judgment in conference.

Provisional Statement of the Results of the Inquiry as to Causation.

Provisional statement of results.

As will appear in the progress of the report, the main practical question to be solved is the cause of diarrhœal mortality in children under five, and especially in infants under one year of age. It is the mortality at these ages which occasions the mountain of deaths from diarrhœa which has been generally observed in the summer season of the year, especially in Leicester and other of our large towns. The governing authority of Leicester, unaware of the breadth and logical difficulties of the inquiry, are naturally impatient to obtain the practical results of my eight years' work at the subject, and perhaps other local sanitary authorities, although more reticent of expressing their impatience, are similarly desirous of knowing them.

I may therefore, for their interim satisfaction, make the following brief statement as to the broad results of my inquiry, premising that what I am now about to say is *provisional only*, and must be clearly understood to be so. I hold myself at liberty in a future report to withdraw or qualify statements made under this heading, as my closer analysis of facts shall hereafter indicate.

The causes of infant diarrhœal mortality are multifarious, the influences bearing upon infants and the circumstances under which they are placed reacting on one another, now by an assisting now by a repressing operation.

The following are a selection of the more important of those conditions which I find commonly regarded in the profession as influencing diarrhœal mortality,* or are shown by my own observations to be of importance:—

A.—General Conditions.

General conditions: Atmospheric temperature.

1. *Atmospheric Temperature.*—That a high atmospheric temperature conduces to a high diarrhœal mortality, and a low atmospheric temperature to a low diarrhœal mortality, is an established fact which no one can dispute. But my inquiry shows that the influence thus exerted is *not a direct influence*, except in so far as it affects also infant mortality from all causes. It is not the main cause of the diarrhœal mortality. Its influence is very great, *but is exerted indirectly*.

Earth temperature.

2. *Temperature of the Earth.*†—This is a far more important condition. I have made for London and many other towns in the Kingdom a large number of charts‡ showing week by week for many years the earth temperature at a depth of 1 foot from the surface and at a depth of 4 feet from the surface, each chart showing also the diarrhœal mortality of the corresponding weeks. The general result shown by these charts is as follows:—

a. The summer rise of diarrhœal mortality does not commence until the mean temperature recorded by the 4-foot earth thermometer has attained somewhere about 56° Fahr., no matter what may have been the temperature previously attained by the atmosphere or recorded by the 1-foot earth thermometer.

b. The maximum diarrhœal mortality of the year is usually observed in the week in which the temperature recorded by the 4-foot earth thermometer attains its mean weekly maximum.

---

* Diarrhœal mortality is the sum of two factors, namely, prevalence and fatality. Both of these differ in the same place in different years and different periods of the same year.

† In assistance of this part of my inquiry, the sanitary authorities of Leicester and of some other towns have been good enough, when erecting, at my request, instruments for ordinary meteorological observations, to introduce earth thermometers also at their several stations.

‡ I have introduced, by way of a single illustration, at the end of this report, a chart of the sort referred to. It is constructed from data forwarded me by Dr. Page, of Redditch. It does not indeed relate to mortality but to diarrhœal sickness (one of the factors of mortality) at Redditch in the year 1885.

c. The decline of the diarrhœal mortality is in this connexion not less instructive, perhaps more so, than its rise. It coincides with the decline of the temperature recorded by the 4-foot earth thermometer, which temperature *declines* very much more slowly than the atmospheric temperature, or than that recorded by the 1-foot earth thermometer; so that the epidemic mortality may continue (although declining) long after the last-mentioned temperatures have fallen greatly, and may extend some way into the fourth quarter of the year.

d. I do not wish it to be inferred that the atmospheric temperature, and the temperature of the more superficial layers of the earth, exert no influence on diarrhœa. Their influence, however, is little, if at all, apparent until the temperature recorded by the 4-foot earth thermometer has risen as stated above. Then their influence is apparent, but it is a subsidiary one.

3. *Rainfall* exerts an influence on diarrhœa, but (so far as is apparent at present) not equally in all periods of the diarrhœal season. The diarrhœal mortality is greater in comparatively dry seasons and less in wet seasons, especially if the drought on the one hand, and the rainfall on the other, be remarkably protracted and excessive. But here again the tendency of the inquiry has been to show that the influence exerted is not direct (*e.g.* by a washing of the atmosphere, so to speak), but indirect, namely, by its effect mainly in preventing the rise and (probably to a less extent) in hastening the fall of the temperature of the earth.

4. *Air Movement.—Wind and comparative Calm* affect the diarrhœal mortality. Other things being equal, calm in the diarrhœal season promotes it, and high winds tend to lessen it.

B.—Conditions of Locality.

5. *Elevation above Sea Level.*—This has apparently an influence on diarrhœal mortality, but not a very remarkable or powerful one. It is an influence which, when we regard large areas, is lost sight of in the midst of much more powerful influences, and is not perhaps to be distinctly seen until we compare among themselves the different parts of comparatively small areas. In such areas we may often see that the lower levels are more affected than the higher levels; but even here it is not easy to estimate the extent of this influence on account of the disturbance of the result by other more potent influences. But even when most obvious, it has appeared to me that elevation is not an influence that bears specially upon diarrhœa; it affects also, and to much the same extent, mortality from other causes. It seems, in short, to influence diarrhœal mortality only in so far as it affects infant mortality from all causes together.

6. *Soil.*—I think I am in a position to say that the influence of soil is a decided one; and that, although it may be observed in respect of some other causes of mortality (and so is not altogether peculiar to diarrhœa), it is observable most distinctly in relation to that disease—

a. Where the dwelling-houses of a place have as their foundation *solid rock*, with little or no superincumbent loose material, the diarrhœal mortality is, notwithstanding many other unfavourable conditions and surroundings, low, and indeed may be almost altogether unnoticeable. Deep and wide and frequent fissuring of the rock in a town, or superficial alternations of rock with looser material, modify this immunity.

b. On the other hand, *a loose soil*, permeable more or less freely by water and by air, is a soil on which diarrhœal mortality is apt to be high. So far as I can see at present, of all natural soils, sand is the most diarrhœal, other things being equal, unless I class with it surface mould to a considerable depth. Gravel (a very indefinite term, which has a different meaning in different places) varies in its relation to diarrhœal mortality in proportion as the loose element of it, or the stony element and the size of the stones it contains, vary. The more gravel approaches to sand in its fineness, or to rock in its coarseness, its relation to diarrhœa appears to be greater or to be less. Dwellers on loose slabby rock, as commonly seen overlying solid rock, have more or less diarrhœa in proportion as the slabby material is in small pieces and mixed with looser earthy matter, or in larger blocks with little intervening earth. Clay soils, other things being equal, do not appear to be, in themselves, among those soils specially favourable to high diarrhœal mortality; when they have seemed to be so, the connexion has appeared to me to be otherwise explicable. A soil which is a mixture of clay, sand, and stones (commonly called a "marl") is apparently favourable or

Causation of "Diarrhœa," by Dr. Ballard.

unfavourable to diarrhœal mortality in proportion as it is loose and permeable on the one hand, or plastic on the other.

c. The presence of much *organic matter* in any soil renders it distinctly more favourable to high diarrhœal mortality than it otherwise would be. Such organic matter (organic fouling) however need not be specially of a fœcal or excremental nature to exert this influence. Hence diarrhœal mortality is apt to be high where dwellings are built upon made ground, the refuse of towns, or upon the site of market gardens; or where the earth beneath and about dwellings is polluted by neighbouring collections of liquid filth in cesspits, or where sewage has soaked into it from imperfect drains and sewers, or from the surface of the ground. It is the opportunities for the collection of organic filth in the fissures of certain kinds of rock that seem to impart to these rocks, where towns are built upon them, a diarrhœal character.

d. Moisture or dryness of a soil.—Excessive wetness and complete dryness of soil appear to be both unfavourable to diarrhœa. A degree of moisture specially favourable is an amount of habitual dampness which is decided although not sufficient to preclude the free admission of air between the constituent physical elements of the soil. Such a degree of dampness occurs when in the diarrhœal season the subsoil water stands sufficiently near to the surface to maintain by capillary attraction the dampness brought about by previously greater nearness of the water to the surface; or when the soil, as in the case of marls, contains sufficient of the clayey element to imprison enough of the water saturating it at some time previously. It is scarcely necessary to add that the requisite degree of dampness may be produced, not only from a source below, but from a surface source: for instance, it may be the result of a previous flood, or of watery matter habitually soaking in from the surface about houses, or from leakages of such conduits as sewers and drains.

Density of population.

7. *Density of Population.*—Aggregation favours, dispersion over area disfavours, diarrhœal mortality. There is nothing new in this: it is (together with the influence of temperature) the lesson annually repeated to us by the Registrar-General, who every year indicates the fact that the diarrhœal mortality of towns much exceeds that of non-oppidan parts of the country, and that the diarrhœal mortality of large towns, on the whole, exceeds that of small towns. The same general lesson is taught by the comparison in particular towns of different parts of the same town such as I have instituted in the course of this inquiry. But it is to be observed that the influence of aggregation of population is noticed also in respect of infant mortality from other causes; it is not limited to diarrhœal mortality, although, as shown in the provisional Table XVI. (p. 77), it appears most marked in the case of diarrhœa. Moreover, it is to be kept in mind that the parts of towns most densely populated are customarily the parts where the inhabitants are of the lowest social grade, and where other conditions favourable to diarrhœa mortality are most abundantly operative. The influence of density of population on the prevalence of diarrhœa is commonly much less direct than in the case of such diseases as measles and scarlatina, although, as will be seen later on, the malady does on occasion spread from person to person.

Density of buildings on area.

8. *Density of Buildings (whether dwelling-houses or other) upon Area.*—This is a different thing from density of population upon area, as may be seen in almost every factory town, although, very commonly, the two conditions are combined. My inquiry tends to show that in a town, crowding of buildings of whatever sort in such a way as to cover area more or less closely with buildings promotes diarrhœal mortality. This condition is seen in operation, for instance, most distinctly in parts of factory towns where buildings other than dwelling-houses occupy much of the space, and where, consequently, the density of resident population on the area is not so great as it would be if the same space were covered wholly with dwelling-houses. It is probable that this difference of density of buildings upon area is one of the circumstances which have to do with the difference of diarrhœal mortality between large and small towns.

Restricted circulation of air.

9. *Restriction of and impediments to the free circulation of air* promote diarrhœal mortality.

a. About dwellings.—One cause of restriction and impediment lies in the condition last-mentioned; this is most obvious where small dwellings are shut in amongst large and tall buildings, as in many courts and narrow streets of factory towns. Such cause is also seen in operation where streets are built in such a direction or are so arranged (*e.g.*, like the mortar between bricks in a

wall) as that they cannot be swept by the prevalent winds of the diarrhœal season; or where the space at the rear of houses in a street, or between neighbouring streets, similarly cannot be swept by currents of air, *e.g.*, when the space between the rears of the houses is narrow, and the ends of such space are obstructed by the buildings of a cross street, or in any other way. Very long, narrow streets, especially under the above-mentioned circumstances, are apt to present an excessive diarrhœal mortality. Openly built towns, which from their surface configuration are so arranged that impediments to the circulation of air are comparatively trifling, have, as a rule, a less diarrhœal mortality than those in which impediments abound, other things being equal.

Causation of "Diarrhœa," by Dr. Ballard.

b. Within dwellings.—The dwellings in which the free passage of air through them is most effectually prevented are those which are built "back-to-back." Taking these, then, as criteria, it may suffice to say that the results of the Board's inquiry* into the mortality from diarrhœa and other causes in dwelling-houses of this sort are to the following effect, namely, that the absence of free domestic ventilation increases very greatly and very obviously the mortality from diarrhœa, and this very much more than it increases the mortality from all causes put together, more indeed than it does the mortality from the seven principal "zymotics" put together, and very much more than it affects the mortality from all causes except these seven "zymotics."

10. *Domestic darkness and general dirtiness of dwellings* are conducive to diarrhœal mortality. Dirtiness, with bad ventilation, constitutes the condition known as "fustiness." It is a commonplace condition in the crowded and poor parts of towns; and it is very much in the parts where these conditions prevail that the diarrhœal mortality is highest. But these conditions are so associated with other conditions conducive to the same result, that I cannot at the present time define the extent of the influence of this special cause apart from them. The fact, however, is notorious. I am satisfied from my own observations that, among the same class of people, the diarrhœal mortality is greater in proportion as general fustiness prevails in their dwellings. Darkness of dwellings is rarely associated with cleanliness or satisfactory ventilation. The influence of "fustiness" and its frequent concomitant darkness is, I think, more obvious in respect of diarrhœa than in respect of the mortality from other causes.

Dirtiness and "fustiness."

11. *Sewer or cesspool emanations*, especially in a concentrated form, and suddenly let loose, may occasion attacks of fatal diarrhœa; emanations of this sort, I think I have reason to believe, are of themselves capable of occasioning a diarrhœal epidemic even in a non-diarrhœal season of the year; and hence in a diarrhœal season such emanations may well be believed to have an influence on epidemic diarrhœal mortality. Unusual diarrhœal mortality may, however, from time to time be observable in localities where there are no sewers to emit foul air, and where there is no reason for believing that cesspool emanations have been previously unusual in amount or have gained access to dwellings with unusual readiness.

Sewer, &c., emanations.

12. *Atmospheric fouling from mere Coal Smoke or from the Gaseous Emanations of Chemical Works or of Chemical Refuse* appear to be inoperative, at any rate in neighbourhoods habitually exposed to them, except in so far as such atmospheric fouling may lower the general standard of infant health.

Ordinary air-fouling.

13. *Filthy Accumulations of Domestic Refuse in Privies, Ashpits, Dustbins, &c.*— Comprising, as these do, an abundance of decomposing organic material, animal and vegetable, such accumulations promote, wherever they exist, diarrhœal mortality; but especially they do so where free movement of air is impeded, and the atmospheric fouling due to them is consequently concentrated. Fixed receptacles of filth may remain dangerous, even when emptied, on account of the encrusted state of their walls.

Filthy accumulations.

14. *Undefined polluted conditions of Drinking Water* have from time to time appeared to give rise to epidemic diarrhœa, and this irrespective of the season of the year; but, so far as I have been able to ascertain, water pollution has little or nothing to do in the way of direct causation with the diarrhœal mortality that occurs annually in this country in the summer.

Polluted drinking water.

---

* "Joint Report by Dr. Barry and Mr. P. Gordon Smith, on Back-to-back Houses," p. 40.

Causation of "Diarrhœa," by Dr. Ballard.

C. Conditions relating to the Population.

Conditions of population: Social position.

15. *Social Position.*—It is notorious, and especially so among Medical Officers of Health, that the diarrhœal mortality of towns is very disproportionately distributed among the several social classes of the population, being comparatively small among the well-to-do portion of the community, and comparatively very great among families of the lower social grades. The more closely this general belief is looked into, the more confirmation it gains. Dr. Grimshaw's Tables, in his paper on "Class Mortality Statistics" (British Medical Journal, August 13, 1887), give statistical evidence in this direction; but a careful study of Dr. Grimshaw's figures indicates that this condition influences the mortality from all other causes even to a greater extent than it does diarrhœal mortality alone. But, although I have thought it desirable to advert to this consideration, it must not be forgotten how much this term "social position" involves, when we compare the well-to-do with the poorer classes of the community, and each with an intermediate class, both as respects the localities in which they severally dwell, and the circumstances under which they live.

Food.

16. *Food.*—Although there is, I think, ground for the popular notions which associate epidemic diarrhœa with the consumption of articles of diet, the almost equally common notion that such diarrhœa arises from indigestibility of food or from faulty digestion on the part of the consumer of it, is not, I am disposed to believe, so well founded: rather I am inclined to think of epidemic diarrhœa due to food as arising through some extraneous substance in the food, which substance is by itself an efficient cause of the malady.

a. As regards the influence of the *mode of feeding* of young infants, the incidence of diarrhœal mortality upon infants fed on the one hand exclusively on the breast, and on the other hand partially or entirely upon other kinds of food is of special interest. The general conclusions arrived at by medical men who have studied the matter, and by Medical Officers of Health who have adduced statistics in support of their opinions thereon, are generally to the effect that infants fed from the breast are remarkably exempt from diarrhœa as compared with infants that have been fed otherwise; and that feeding from "the bottle" has been principally concerned in the fatal diarrhœa of infants. But my difficulty about accepting these conclusions in their entirety has hitherto been absence of data as to the proportion of healthy children fed in these different ways. In this difficulty Dr. Hope, the Assistant Medical Officer of Health for Liverpool, has come to my assistance and has made some comparative statistical inquiries among infants in that city who were healthy, and among others who had died of diarrhœa in the summer season. And the general result of his inquiry, so far as I have at present worked upon his tables, is this: 1st. That infants fed solely from the breast are remarkably exempt from fatal diarrhœa even among the low class Irish, the degree of exemption being exactly the same among the Irish as among the English and other races in his city. 2nd. That infants fed in whatever way with artificial food to the exclusion of breast milk, are those which suffer most heavily from fatal diarrhœa. 3rd. That children fed partially at the breast, and partially with other kinds of food, suffer to a considerable extent from fatal diarrhœa, but very much less than those who are brought up altogether by hand. 4th. As respects the use of "the bottle," that it is decidedly more dangerous than artificial feeding without the use of the bottle.

b. It is to be inferred generally from observations which I have made that the circumstances of *food keeping*, of its exposure to telluric emanations (*e.g.*, in underground cellars), or to emanations from accumulations of domestic filth, &c. (*e.g.*, when kept in pantries, &c., to which such emanations have more or less free access), tends to render it liable to produce diarrhœa, especially where the storing place of food is dark, and is not exposed to currents of air.

Maternal neglect.

17. *Maternal neglect and carelessness in infant management.*—In estimating (apart from other considerations already mentioned) the influences of this element of causation, I adopt as a criterion the prevalence of fatal diarrhœa among infants who are illegitimate as compared with its prevalence among the legitimate. The collective experience of three places, Salford, Great Yarmouth, and Scarborough is for all practical purposes to this effect, viz.:—1st. That the infants most liable to be neglected, namely, those which are illegitimate, suffer exceptionally from all causes of infant mortality, but

from diarrhœal mortality rather more than from other causes of death. 2ndly. That in years of high epidemicity this greater tendency on the part of the illegitimate infants to suffer from diarrhœal mortality is lost sight of. 3rd. That in years of low epidemicity the tendency above mentioned is most obvious, *i.e.*, the presumably less potent or less abundant specific cause (in such years) operates fatally more easily on the illegitimate than on the better cared-for class of infants. 4th. In a highly epidemic year this class of infants seems to suffer earlier than the class better cared for. Causation of "Diarrhœa," by Dr. Ballard.

18. *Occupation of females from home.*—This, which has often been assigned by Medical Officers of Health and others as a fruitful cause of infantile fatal diarrhœa, resolves itself mainly into the question of maternal neglect, with the substitution more or less of artificial feeding for feeding at the breast,—matters which have been dealt with in preceding paragraphs. (But see Provisional Table XVI., p. 77.) Female occupation.

Having regard to the broad facts already indicated, and to others which have yet to be exhibited by me, a working hypothesis or provisional explanation that would best accord with the totality of the evidence in my possession bearing on the production of epidemic diarrhœa may be stated as follows :— Provisional hypothesis.

That the essential cause of diarrhœa resides ordinarily in the superficial layers of the earth, where it is intimately associated with the life processes of some micro-organism not yet detected, captured, or isolated.

That the vital manifestions of such organism are dependent among other things, perhaps principally, upon conditions of season and on the presence of dead organic matter which is its pabulum.

That, on occasion, such micro-organism is capable of getting abroad from its primary habitat, the earth, and having become air-borne obtains opportunity for fastening on non-living organic material, and of using such organic material both as nidus and as pabulum in undergoing various phases of its life history.

That in food, inside of as well as outside of the human body, such micro-organism finds, especially at certain seasons, nidus and pabulum convenient for its development, multiplication, or evolution.

That from food, as also from the contained organic matter of particular soils, such micro-organism can manufacture, by the chemical changes wrought therein through certain of its life processes, a substance which is a *virulent chemical poison ;* and

That this chemical substance is, in the human body, the material cause of epidemic diarrhœa.

It will be observed that this provisional hypothesis is sufficiently elastic to include, as a common cause of diarrhœa, chemical products of bacterial life manufactured indifferently within or outside of the human body. Elasticity, to this extent, of a provisional hypothesis has been necessary for the reason that, in the present state of our knowledge, certain cases and groups of cases of diarrhœa, not distinguishable from epidemic summer diarrhœa, have now and again been found to possess the faculty of being directly communicable from person to person. The account of Dr. Bruce Low's experience at Helmsley in Yorkshire appended to this Report (Appendix H.) is illustrative of this class of cases.

It will be obvious that in the stools of such infective cases of diarrhœa the hypothetical organism causative of the malady may be looked for with good hope of success.

Provisional Practical Suggestions to Sanitary Authorities.

These are based upon the foregoing results of the inquiry as to causation, in so far as the "causes" above enumerated are such as a Local Authority has statutory power to deal with and to modify, or such as it may endeavour to get modified by appropriate advice. Practical suggestions.

1. The first object which a local authority desirous of lessening its diarrhœal mortality should have in view is to prevent the fouling of the soil with matters out of which the material of diarrhœa can be produced. This object is to be attained by providing, *a*, for the constant removal of liquid filth and sewage by means of proper conduits (drains and sewers), proper in the sense that they shall, even to their very inlets, be constructed or imbedded in such a manner that there can be no passage of the liquid, material they are intended to convey away, outwards into the soil; *b*, for the daily removal of all filth (useless organic matters) of a nature not conveyable by drains, &c. Liquid and solid filth removal.

Causation of "Diarrhœa," by Dr. Ballard.

No prolonged storage of such matter in ashpits, dust-bins, dung-pits, about pigsties, &c., should be allowed.

Domestic cleanliness.

2. The cleanliness of the interior of domestic premises should be sedulously looked to and maintained, for filth (organic matter which can be infected by the contagium) often lodges here as well as in storage receptacles purposely provided for it.

Dryness and cleanliness of soil.

3. The dryness and cleanliness of the soil in towns (and especially in the poorer parts of towns) should be further provided for by procuring the effectual sealing of the surface of the ground immediately about dwellings by means of uniform *impermeable* material (such as cement), from the surface of which all water that falls may, *with certainty*, be carried off into the sewers, and which shall further prevent free passage of air from and into the soil. The same applies to the surface of such places as cow-sheds, stables, pigsties, &c.

Lowering of ground water.

4. In places where the ground water rises at any time to within such a distance of the surface as to render the first few feet of the soil habitually damp by capillary attraction from it, the most strenuous endeavours should be made by the authority to *lower it permanently* to such a point as shall prevent this *dampness* of the soil, and so ensure that the first few feet of earth shall be dry.

Preventing rise of ground air.

5. In places where the soil is already polluted by or contains organic matter (as is the case with all soils which are not absolutely hard and rocky), the whole surface of the earth beneath houses should be so effectually and uniformly sealed with impervious material, such as concrete, as to prevent any chance of emanations rising into them from the soil. This should be done even in the case of new houses, not only as a precaution against the rise of ground air which may by chance become infective hereafter, but because the earth of fields and of land which has been cultivated (*e.g.*, of the former sites of market gardens) is more or less loaded with organic débris. Hence also a common practice of not only leaving unremoved the sods from the interior of buildings in process of erection, but of adding to them the sods from the footings of the walls, should be prohibited.

Free ventilation about and within dwellings.

6. Free atmospheric dilution of polluted air, to be brought about only by free movement of air among and within dwellings—which is what the term "free ventilation" means—is an effectual means of lessening the energy of a present contagium. Of this I am perfectly certain. There can be no question whatever that to attain this end, and to attain it with the greatest completeness, should be one grand object of a sanitary authority wishing to lessen its diarrhœal death rate. For attaining it in older parts of a town Parliament has given ample powers, under such Acts as the Artizans and Labourers Dwellings Acts, so far as the free ventilation about dwellings is concerned. For new dwellings it is in the power of the authority to prescribe the width of streets, the provision of free space about dwellings, and to regulate the laying out of new streets. So far as is practicable the line of new streets should be such as will permit the free traversing of them by the prevailing wind in the summer season of the year. In any case free movement of air should be secured at the back as well as in the front of every house; and in addition the line of houses in a street should be broken at frequent intervals by a cross street or open space, to permit also of the transverse passage of the wind. Domestic ventilation is provided for by the Public Health and Nuisances Removal Acts, which local sanitary authorities are not only empowered, but which it has now been made their duty to enforce. The erection of "back-to-back" houses should not be permitted.

Protection of food from infection.

7. I am not prepared to name any kind of food which may not become infected with the contagium of this malady. Care should be taken to protect food of all kinds from this infection, but special care should be taken for the protection of milk, the staple article of food of artificially fed infants. Milk may become infected at any time from that of its leaving the cow's udder to the time of its being used as food. Hence the necessity of guarding it from infection in the cow-shed, in the storing place of the dairyman, in the house of the retailer, and in the dwelling of the consumer. Over every one of these places a local sanitary authority now has control. This control should be exercised by taking care that the cow-sheds themselves are paved with uniform and impermeable material and kept constantly clean and airy, and that all manure and filth is removed daily from their neighbourhood; the most perfect models of such places being adopted as pattern. The conventional cleanliness is insufficient. Next, the dairy should be similarly protected from the rise of ground air and very freely ventilated indeed. No milk retailer should be registered who has not a proper place outside his dwelling in which to keep his milk, a place similarly perfectly clean, protected against ground air, and very freely ventilated. The practice often adopted in Leicester and some other towns of storing milk on the ground floor of a dwelling-

house or in some underground cellar should be altogether discouraged. Lastly, there is the rule, not only applicable to the keeping of milk, but of food of all kinds, that the pantries of houses should be properly constructed; certainly they should not be underground cellars or cellar "stair heads," as is commonly the case in Leicester, but be open to free ventilation, light, cool and dry, and protected against the rise of ground air. Local authorities cannot enforce this recommendation, but they may take measures to make the importance of the provision known generally through their district. As to the offering for sale of stale and over-ripe fruit or doubtfully wholesome meat, and as to the sanitary condition of bakehouses and other places where food is prepared and sold, the local authority has ample powers of control, and these powers they should exercise. They may usefully recommend that consumers should boil all milk on its receipt into their houses.

Causation of "Diarrhœa," by Dr. Ballard.

8. It may be observed that, except in one respect, I have made no reference to sewers and drains or to sewer and drain emanations as conveyors of the diarrhœa contagium. This is not because I am not perfectly aware that foul emanations from such conduits may occasion diarrhœal disease. Indeed I have, I think, solid grounds for believing that outbreaks of diarrhœa are sometimes thus occasioned, as well as by foul emanations from cesspools and other receptacles of decomposing organic filth. But the public mind is, I believe, fully aware of this danger, and nothing that I can say is likely to enhance the appreciation of it. Nor need I add that the abolition of improper receptacles of filth and the free flushing and ventilation of drains and sewers, with due provision against the entry of foul air from them into dwellings and work places, is a matter which a sanitary authority is bound to see to. I have preferred to dwell most upon such points of precaution as are less likely to receive attention.

Due regulation of sewers and drains.

9. And lastly, I have to say that whatever may be the essential cause of the malady, everything that promotes general ill health in a population probably renders it more liable to attack, and certainly inclines the illness towards a fatal issue.

Measures of general sanitation.

Now there is not one of the above provisional inferences which it has been considered desirable that I should give expression to, and no one point of advice based upon them, with which the sanitary authority of Leicester is not specially concerned. To carry out the advice given will no doubt be a most costly proceeding. With that I have nothing to do. Sanitary faults are and ever must be costly, costly in human life or costly in pecuniary expenditure. Leicester is no doubt at a disadvantage as to its site (a matter to which I shall have to allude in another part of my report), but the greater is the reason that this disadvantage should receive compensation by every means that the Corporation are empowered to adopt. They have already launched themselves upon the proper course, since during the few years past that I have had occasion to make acquaintance with the town and its sanitary government, great works have been accomplished and much that was greatly needed is still being done for its sanitation.

Applicable to Leicester.

Causation of "Diarrhœa," by Dr. Ballard.

REPORT.

Contents of Report.

TABLE OF CONTENTS.

APPENDIX.

I.—PROPORTIONS OF THE DIARRHŒA SICKNESS AND MORTALITY.

Proportions of diarrhœal sickness and mortality:

If any justification be wanted of the multifarious directions in which the present inquiry has been carried, it will at once be found in the importance of the subject matter as measured by the rank of "diarrhœa" among the disabling and fatal diseases habitually prevailing in England. And some account therefore of diarrhœa from this view point will form a fitting prelude to a report upon the results of the investigation.

Of diarrhœal illness.

(*a.*) As regards the *amount of illness referable to diarrhœa:*—Out of 272,469 newly occurring cases of sickness among the recipients of gratuitous or charitable medical assistance in the parish of Islington† during a period of 12 years (1857 to 1868 inclusive) 16,479 were cases of so-called "diarrhœa,"* "dysentery," or ordinary "summer cholera."

Some idea of the relation which the prevalence of these affections bears to the prevalence of some other common but serious maladies may be got from the following table.

Among the 272,469 cases of sickness there were cases—

		Per 1,000 of all cases.
Of respiratory diseases (bronchitic or catarrhal affections, asthma, pneumonia, and pleurisy)	47,889	175·8
Of diarrhœal affections	16,479	60·5
Of measles	5,501	20·2
Of whooping-cough	4,580	16·8
Of scarlatina	3,850	14·1
Of small-pox	1,977	7·3

It is a matter of ordinary professional experience that these diarrhœal affections are not equally prevalent every year (especially every summer). Some notion of this annual variation is to be gathered from another of my published Islington tables, which shows that—

* I take it that the ordinary custom of the medical profession is to regard as "diarrhœa," and to record as such, cases of intestinal flux which cannot be attributed to any specific fever, to tubercular disease, or to known diseases of organs, affections of which are more or less apt to be thus associated. The diagnosis of "diarrhœa" is thus arrived at usually by a mental process of "exclusion."

† *See* p. 22, "Sources of data."

Causation of "Diarrhœa," by Dr. Ballard.

In 1857	there were	1,375	cases,	=	10·7	per cent.	of all the cases treated.
1858	,,	868	,,	=	6·3	,,	,, ,,
1859	,,	1,322	,,	=	8·8	,,	,, ,,
1860	,,	721	,,	=	3·3	,,	,, ,,
1861	,,	1,395	,,	=	6·0	,,	,, ,,
1862	,,	957	,,	=	4·0	,,	,, ,,
1863	,,	1,357	,,	=	5·1	,,	,, ,,
1864	,,	1,204	,,	=	5·0	,,	,, ,,
1865	,,	1,325	,,	=	5·7	,,	,, ,,
1866 (cholera year.)	,,	2,586	,,	=	9·4	,,	,, ,,
1867	,,	1,341	,,	=	4·9	,,	,, ,,
1868	,,	2,028	,,	=	6·2	,,	,, ,,

Of diarrhœal mortality.

(*b.*) As to *mortality from diarrhœa* :—The mortality and death-rate tables published by the Registrar-General indicate the amount of mortality due to diarrhœal affections (including dysentery). During the ten years 1861 to 1870, out of 4,794,500 deaths registered from all causes, 207,256 were referred to this cause; and during the ten years 1871 to 1880, out of 5,178,311 deaths, 221,552 were thus referred. This is equal to 43·2 per 1,000 of all the deaths in the first period of ten years, and to 42·7 per 1,000 of all the deaths in the second period. Some further notion of the importance of diarrhœal affections as a cause of national mortality is to be gathered from a similar comparison to that above made in reference to diarrhœal sickness. Thus—

In the ten years 1861 to 1870 there were registered in England and Wales 4,794,500 deaths, and of these there were referred—

		Per 1,000 of all deaths.
To respiratory diseases	709,601 =	150·0
diarrhœal affections	207,256 =	43·2
scarlatina	207,867 =	43·3
whooping-cough	112,800 =	23·5
measles	94,099 =	19·6
small-pox	34,786 =	7·3

In the ten years 1871 to 1880 there were registered in England and Wales 5,178,311 deaths, and of these there were referred—

		Per 1,000 of all deaths.
To respiratory diseases	915,340 =	176·8
diarrhœal affections	221,552 =	42·7
scarlatina	174,232 =	33·6
whooping-cough	124,532 =	24·0
measles	91,948 =	17·8
small-pox	57,422 =	11·0

As I shall have occasion soon to use for the purpose of this report my records of sickness and mortality in Islington, it may be well to point out here that the above figures for England and Wales correspond sufficiently closely with those of a similar table of the deaths in Islington in the 12 years 1857 to 1868, viz. :—

		Per 1,000 of all deaths.
Deaths from all causes	40,071	
,, respiratory diseases	7,138 =	178·1
,, diarrhœal affections	2,220 =	55·4
,, scarlatina	2,007 =	50·0
,, whooping-cough	1,756 =	43·8
,, measles	1,142 =	28·4
,, small-pox	475 =	11·8

It will be observed that, as a cause of death, these diarrhœal affections contribute as largely to the mortality of the country (latterly they have contributed to it more largely) as scarlatina, one of our most dreaded acute "zymotic" maladies; considerably

Causation of "Diarrhœa," by Dr. Ballard.

more too than measles, whooping-cough, or small-pox, as largely indeed as measles and whooping-cough put together; and that in Islington during the years referred to, diarrhœa contributed to the total mortality more largely than even scarlatina.

I am referring here to the *immediate* mortality caused by "diarrhœa;" but I question very much if this is by any means *all* the mortality that results from it. I shall have occasion to demonstrate in the course of this report (as one issue of the pathological investigations instituted in connexion with the inquiry) the fact that epidemic diarrhœa implicates the kidney as well as the intestinal canal, and in a manner similar to that in which *scarlet fever* implicates it. Probably, in most cases of "diarrhœa" that recover, the morbid condition of the kidney clears up, as it does in most cases of scarlet fever that recover; but, just as in other cases of scarlet fever that recover from the immediate illness. the foundation of chronic disease of the kidney may have nevertheless been laid,—disease which may, perhaps under the designation of one of its secondary results, prove ultimately fatal, or which may give a fatal tendency to some future illness from which a patient would otherwise be expected to recover,—so it may also be with the kidney affection (similar in character) which is associated with diarrhœa. Indeed, it is not improbable that a previous attack of "diarrhœa" may have been the origin of many a case of chronic Bright's disease which so far as the patients' medical history is concerned has appeared inexplicable.

The great importance, then, of investigating the nature and etiology of this malady "diarrhœa," which thus swells our national death roll, may be considered established.

(*c.*) Inthis connexion it may be useful here to introduce a Table, and at end of report two charts (Charts I. and II.), drawn from the Annual Reports of the Registrar-General which show the mortality from diarrhœa and the diarrhœal death rate per 1,000 of population at all ages in England and Wales and in London respectively for each year from the commencement of death registration. I have added upon the charts the mean temperature (Greenwich) for each year and for each quarter, and a line upon the charts indicating the variations of the mean temperature third quarter by third quarter.

TABLE showing the NUMBER of DEATHS from "DIARRHŒA and DYSENTERY" REGISTERED in ENGLAND and WALES and in LONDON, and the ANNUAL MORTALITY per 1,000 PERSONS LIVING during the 50 Years 1838–87.

[*From the Registrar-General's Annual Reports.*]

Years.	England and Wales.		London.		Years.	England and Wales.		London.	
	Deaths.	Rates per 1,000 living.	Deaths.	Rates per 1,000 living.		Deaths.	Rates per 1,000 living.	Deaths.	Rates per 1,000 living.
1838	3,109	0·20	498	0·28	1863	15,994	0·78	2,492	0·86
1839	3,099	0·20	455	0·25	1864	17,432	0·83	3,013	1·02
1840	4,097	0·26	522	0·28	1865	24,603	1·16	3,721	1·24
1841	3,755	0·24	543	0·29	1866	18,266	0·85	3,294	1·08
1842	6,002	0·37	855	0·45	1867	20,813	0·96	3,060	0·99
1843	—	—	1,005	0·51	1868	30,929	1·41	4,110	1·31
1844	—	—	831	0·41	1869	20,775	0·93	3,495	1·10
1845	—	—	940	0·45	1870	26,126	1·16	3,814	1·18
1846	—	—	2,308	1·09	1871	24,937	1·09	3,968	1·21
1847	14,842	0·87	2,283	1·04	1872	23,034	1·00	3,588	1·08
1848	13,696	0·79	2,247	1·00	1873	22,514	0·96	3,950	1·17
1849	20,881	1·19	3,837	1·68	1874	21,888	0·92	3,201	0·93
1850	13,504	0·76	2,077	0·89	1875	24,729	1·03	3,289	0·94
1851	16,913	0·94	2,755	1·16	1876	22,417	0·92	3,585	1·01
1852	20,373	1·12	2,513	1·04	1877	15,282	0·62	2,421	0·67
1853	16,083	0·87	2,649	1·08	1878	25,103	1·00	3,534	0·97
1854	21,995	1·18	3,325	1·33	1879	11,463	0·45	1,894	0·51
1855	14,207	0·75	2,190	0·86	1880	30,185	1·17	3,738	0·99
1856	15,150	0·80	2,414	0·93	1881	14,536	0·56	3,055	0·80
1857	22,887	1·19	3,298	1·25	1882	17,185	0·65	2,144	0·55
1858	15,331	0·79	2,220	0·83	1883	15,933	0·60	2,652	0·67
1859	19,710	1·00	3,513	1·29	1884	26,412	0·97	3,903	0·97
1860	10,858	0·55	1,485	0·54	1885	13,398	0·49	2,723	0·67
1861	20,162	1·00	2,740	0·97	1886	24,748	0·89	3,996	0·96
1862	12,156	0·60	1,839	0·64	1887	20,242	0·72	3,773	0·90

One reason for introducing the above table and charts is, that I desire that it should at once be made apparent, as it will be from the most cursory study of the charts, that, while the general fact of temperature influence on the amount of diarrhœal mortality, especially in the summer season, cannot be disputed, air-temperature will not account for everything; for if it did we should not find such discrepancies in amounts of mortality in years which were alike in the mean temperature of their third quarter. It must be evident that other factors are operative. What these factors are it is one of the objects of this inquiry to discover. Causation of "Diarrhœa," by Dr. Ballard.

During the early years of registration there was necessarily much less reliance than now to be placed upon the statements made as to the cause of death, since the custom of medical certification has become more universal; so that probably the figures given for the earliest years must be taken with some allowances for incompleteness.

II. Synonyms of Diarrhœa.

The most frequently used term is "diarrhœa." This term designates a complex malady by the name of its leading symptom. Other terms, however, are in use. "Choleraic diarrhœa," "English cholera," "Cholera nostras," "Infantile cholera," are terms used sometimes to designate very severe cases which in one way or another appear to the persons using these terms to assimilate to true cholera. Often such terms as "enteritis," "muco-enteritis," and "gastro-enteritis" are employed, the person using them desiring to signify that he recognises in the illness an inflammatory condition of the digestive mucous tract. When bloody stools or tenesmus occur the disease is often designated "dysentery" or "dysenteric diarrhœa." There is obviously a good deal of fancy in the selection of any particular term as it is met with in public records, the terms "diarrhœa," "dysentery," "dysenteric diarrhœa," "cholera," and "choleraic diarrhœa" being those most commonly used in the diarrhœal epidemic seasons, both in the case of infants and older persons; at other seasons the other terms are found to be more used, but still the term "diarrhœa" predominates. Moreover, the term "cholera" or "choleraic diarrhœa" is applied less frequently to the severe malady of infants than when a similarly severe case occurs in older persons. Synonyms.

I may be permitted to add that I have satisfied myself as regards public records of classified mortality, that though all deaths certified in every one of the above ways be included with "diarrhœa," nevertheless many other deaths directly due to that disease may remain omitted from their proper class. This is especially true of the deaths which are registered during the epidemic season; but the remark applies almost solely to infants. The hurry of extensive medical practice, especially in large and manufacturing towns, results I fear in a good deal of hurried, incomplete, and unscientific certification of the cause of death in infants; so that many diarrhœal deaths during the epidemic season get registered under the terms "atrophy," "marasmus," "want of breast milk," &c., which are sometimes antecedent conditions determining the fatal issue; or under the terms "convulsions," "hydrocephalus" (meaning mostly, I presume, the "hydrencephaloid disease" of some writers), "vomiting," &c., which, like diarrhœa, are elements in the condition of the patient met with at some period, often the final period, of the malady. But for my purpose the error is of little consequence, since it is of general occurrence in all parts of the kingdom, and so can affect only to a trifling extent any comparisons instituted between different places or the same place in different years. Nor, the error being thus recognised, does it detract from the extreme value and usefulness to the investigation of the mortality records of the General Register Office.

III. Pathology of Diarrhœa.

This has, with the assistance of Dr. Klein, whose services as a pathologist have been invited by the Board in aid of this inquiry, been studied upon such bodies of infants dead of the malady as were available for the purpose. The opportunities were fewer than could have been wished for, but the uniformity of the morbid conditions discovered makes up to some extent for this deficiency. Pathology.

In the bodies examined there were marked pathological changes not only in the intestines, but in all the viscera, and not alone in the viscera of protracted cases, but in those of infants the total duration of whose illness had not exceeded 12 or 14 hours. For the most part the intestines were empty, or only contained a little yellow fœcal matter, or a little opalescent mucoid fluid, or the surface was coated Alimentary canal.

Causation of "Diarrhœa," by Dr. Ballard.

with some thick creamy catarrhal exudation. The amount of obvious hyperæmia of the mucous membrane of the stomach and intestines varied: sometimes there was observed some follicular ulceration, both in the small and large intestine. Generally there was more or less inflammatory thickening of the mucosa, and even in the cases of only a few hours' duration, denudation of the epithelium, both of the stomach and intestines. Now and then ecchymoses were seen, or even a little blood effused into the alimentary canal. The solitary and agminated glands of the small intestine were mostly prominent, the mesenteric glands were enlarged. The condition of *spleen* varied; it was sometimes congested, or exhibited hyaline degeneration of the arteries, or swelling of the Malpighian corpuscles with degeneration of the central portion of them. The condition of the *liver* varied. It was either congested, or pale and bloodless, the former condition prevailing in the cases of short, and the latter of those of longer duration; but in every case examined there was one invariable condition, namely, fatty degeneration of the liver cells, slight in cases of short (only a few hours') duration, but pronounced and extensive, or complete in all parts of the organ, when the illness had been protracted. The *kidneys*, even when normal to the naked eye, were invariably found to be diseased when examined microscopically, showing inflammatory and degenerative changes, intense glomerulo and parenchymatous nephritis being demonstrated even in cases of very short duration. The *lungs*, although they might be in parts collapsed, presented marked evidence of acute catarrhal or catarrhal and interstitial pneumonia. The *blood* may be inspissated and coagulate imperfectly. There was nothing in Dr. Klein's microscopical investigations of the tissues, blood, or excreta to indicate that in the cases which furnished the organs, blood, or excreta sent to him, the malady was due to any micro-organism developing within the alimentary canal or permeating any of the tissues.* (For details of these investigations, *see* Appendix A.)

Spleen.

Liver.

Kidneys.

Lungs.

Blood.

IV.—Symptomatology of Diarrhœa.

Symptomatology.

The main clinical features of the malady are more or less familiar to medical men and, I may add, to most persons outside the profession; few grown-up people escaping an attack at some period or another of their adult life. Hence I shall confine myself, in what I have to say upon this part of the subject, to the disease as observed in infants and young children, and chiefly to such points as appear to have the most marked bearing upon the pathology of the malady, my remarks being chiefly based upon records I possess of fatal cases.

Sources of data.

Leicester.

(*a.*) *Sources of Data.*—These records were partly obtained in Leicester during the epidemic seasons of 1881 and 1882 by Mr. Power and myself. We remained during the greater part of these seasons in Leicester, and being in personal communication with the sub-registrars of deaths, received immediate information of each diarrhœal death as it was registered, and as speedily as was practicable one or the other of us visited the house, and proceeded to obtain, by a pre-arranged systematic inquiry, all the essential particulars of the illness and the circumstances and conditions under which it had occurred. In this way we obtained records of 340 fatal cases. This was very heavy work even for two observers, and taxed our physical powers to the utmost, since at the same time we had to pursue general as well as detailed investigations into local sanitary conditions, and to collect and work into a useful shape a large mass of statistical records extending back for some years. The character of this part of our work, which involved a minute sub-division of the town into distinctive portions, will be seen and may be judged of by the minute statistical particulars that I shall be thus enabled to present at a later period of my report. While thus, at the risk of greatly protracting the inquiry, we did our best to disarm adverse criticism, I am perfectly conscious of shortcomings which are quite as obvious to ourselves as they can be to others.

Birmingham.

Another step that I took was to obtain from the managers of the Children's Hospital at Birmingham, a large town offering a succession of selected cases, the use of an entire ward for the admission thereinto of such severe cases as might during the epidemic season be brought under observation in its out-patient department. For obtaining this favourable and liberal concession from the managers, I am much indebted to the personal influence exerted by my friend the late Dr. T. P. Heslop, one of the originators of the institution, who took a great interest in the care of sick children, and at once offered to facilitate

* But it must not be therefore inferred that a specific micro-organism may not in some instances be present, and even undergo development and growth within the body. No material from cases of apparently "communicable diarrhœa" was examined by Dr. Klein among the material here referred to. But see Dr. Klein's observations in one particular case at p. 84. See also the suggestion made in connexion with Dr. Bruce Low's cases of Communicable Diarrhœa, at p 7.

my inquiry by every means at his disposal. The arrangement was that every case admitted was to be carefully investigated and a clinical record kept, samples of the bowel evacuations and of blood during life were to be taken into capillary tubes and at once forwarded to Dr. Klein for microscopical and biological examination, and, in the event of death, convenient portions of the viscera were to be hardened in the customary way and also to be sent to Dr. Klein. I looked for great results from this arrangement, which Dr. Welsh, then acting physician to the hospital, engaged to superintend. And in doing so, I believe he did all he could do; but, as will be seen in the sequel, although the inquiry was in a degree advanced by it, I was in many respects disappointed, in consequence, as I was given to understand, of frequent changes in the internal administration of the hospital and in the circumstances attending them.

Causation of "Diarrhœa," by Dr. Ballard.

I have also in the pathological part of the inquiry had help from my friend Dr. H. Ashby, Physician to the Manchester Hospital for Children at Pendlebury, who generously placed his valuable case-books at my disposal, and, in illustration of some of his fatal cases of infantile diarrhœa, furnished for Dr. Klein's examination portions of hardened viscera from these subjects.

Manchester.

(*b.*) *Prodromata.*—There may be no premonitory indications whatever of local or constitutional disturbance. An attack may set in with a suddenness that puts one in mind of the operation of a virulent chemical poison. This is the usual way in which cases of very brief duration but of fatal issue break out. In cases of longer duration before the fatal issue, this sort of sudden attack was observed more and more rarely the more protracted the case subsequently turned out to be.

Prodromata.

The premonitory indications, when observed, consisted of one or more of the following:—"indefinite ailing," the child being observed to be somehow "out of sorts," unusual "crossness" or "fretfulness," or some unaccustomed looseness of the bowels for some few days or even for a few weeks before the attack, a looseness to which it would be exaggeration to apply the term "diarrhœa;" sometimes the premonitory indications have been merely a little feverishness or unusual dulness or "doziness." The fact that in the large majority of cases some one or more of these phenomena were observed before the real "diarrhœal" seizure, seems to show that, although the specific cause if sufficiently potent may operate generally throughout the system with the suddenness of the operation of a virulent chemical poison, it usually first shows its presence in the body by more or less general disturbance of the nervous and vascular systems; one would say, at any rate, that, as a rule, other parts of the body are disturbed before the gastro-intestinal system.

(*c.*) *Phenomena of the Illness.*—The following are the leading phenomena which, each in varying degree and with varying certainty, are observed in the course of the established malady. Diarrhœa, vomiting, convulsive phenomena, a bodily temperature at certain periods above, at other periods below what is normal, reduction in quantity or actual suppression of urine, embarrassed breathing, and, where looked for, commonly physical indications of pulmonary hyperæmia or inflammation, pallor of surface of the body, loss of bulk and flesh, and exhaustion with its various well known clinical features. I must add, that occasionally there is jaundice. Now and then a (fugitive) rash has been observed on the body (*see* Cases X. and XI., p. 85).

Phenomena of illness.

As respects some of the symptoms above enumerated, I must say something more even in such a summary as this. *Diarrhœa.*—I may here state my strong suspicion, almost my belief, that the malady usually characterised by diarrhœa may run its course from first to last, and even to death, without any remarkable diarrhœa at all. In other cases, although diarrhœa occurs, it is by no means the prominent symptom of the disorder; it may be comparatively of trifling amount or of short duration. More frequently, however, it is the prominent symptom, thus giving the malady its name, lasting throughout the illness or only disappearing shortly before death; or it may be intermittent or remittent. The quantity and daily frequency of the diarrhœal discharge vary, but in very sharp and acute cases, or towards the termination of more prolonged cases, bowel discharges may be incessant and deluging, "running like water from a tap." In prolonged cases a change from a diarrhœa moderate in quantity and frequency to a diarrhœa of this last-mentioned sort may take place very suddenly. It is not uncommon for the diarrhœal discharge to cease some hours and even some days before death. There is nothing essential about the colour of the stools: they may be either decidedly mucous or watery, or may present varying degrees of admixture of these appearances. For the most part the stools are offensive, but not invariably. If not offensive at first, they are apt to become so as the diarrhœa proceeds or the fatal illness approaches its termination. A description not infrequently given of the

Diarrhœa.

Causation of "Diarrhœa," by Dr. Ballard.

odour is "horrible and death-like." (*See* Appendix F.) In some cases the stools are stained with blood, and tenesmus or prolapsus ani are observed. *Vomiting.*—In only 43 out of 326 fatal cases occurring in Leicester of which I have notes (and in which the presence or absence of this symptom is mentioned) was vomiting absent altogether throughout the course of the illness. Whether the case was of long or short duration made little difference in this respect. (*See* Appendix D.) In the vast majority of cases the vomiting occurs concurrently with the commencement of the diarrhœa, or, if not concurrently, within a few hours after the first diarrhœal stools. Occasionally it stands alone, perhaps for a whole day, as the prominent feature of the attack, the diarrhœa not appearing until the second day of the illness. As a rule, the shorter and sharper the illness, the earlier in its course does this symptom appear. Once it occurs, it usually recurs from time to time until the termination of the case, and this whatever the total duration of the illness may be. In about a third or fourth of the cases, however, it ceases in the course of the first day's illness, and does not recur. In still fewer instances it only ceases, like the diarrhœa, shortly before death. Occasionally, in cases of over a week's duration, diarrhœa and vomiting have alternated as the prominent symptoms of gastro-intestinal disturbance. It varies in severity, occasionally being the prominent symptom from first to last, and now and then is so severe as to be apparently the principal cause of the fatal prostration. *Convulsive phenomena.*—Only a small per-centage of fatal cases run their course without presenting convulsive phenomena of some kind. (*See* Appendix G.) Mostly they consist of the ordinary well-known "fits" of infantile eclampsia, but in about a fifth of the cases they consist of such minor phenomena as clenching or "working" of the hands, rolling of the head or eyes, twitchings of the limbs, "sawing the air" with the arms, or "inward convulsions" (laryngismus?), such phenomena being mostly observed towards the close of the illness. The regular fits of eclampsia also mostly occur for the first time towards the close of the illness, many very shortly before death (the child sometimes dying during the convulsions). But they may occur quite early in the illness; sometimes even they occur on the first day of the illness, accompanying the commencement of the diarrhœa. After this they may not recur, or, on the other hand, they may recur from time to time during the whole illness, and be even its most prominent feature. The relation of these phenomena to the diarrhœa and vomiting is sometimes very instructive. In some cases, for instance, they first occur when the diarrhœa or vomiting, from being severe, lessen or cease, the eclampsia appearing to replace vomiting in the series of morbid occurrences. In other cases the convulsive phenomena have first appeared when from being moderate the diarrhœa and vomiting have increased perhaps suddenly in severity. There is no apparently necessary connexion, however, between convulsions and the symptom diarrhœa, for the convulsions occur sometimes when the diarrhœa has throughout been moderate in amount In Appendix G. to this report I have described more fully the relation of convulsions to the other phenomena of the malady, and have shown that there is reason to regard them not only as one of the most important phenomena of the malady, but, when occurring, as they mostly do occur, late in the illness, as indicating (and probably then as often due to) an uræmic condition the result of the kidney affection invariably present in these cases. The *comatose condition* in which the patient often dies appears also as a rule due to the same condition of the blood; but in some cases evidences of intra-cranial inflammation have been observed. *Bodily temperature.*—I introduce in this place three charts of rather protracted fatal cases observed and recorded at my request at the Children's Hospital at Birmingham, because they are fairly typical.* One important fact which they indicate, so far as my inquiry is concerned, is the "algide" character of the developed malady. At the commencement there appears to be some little febrile disturbance, but sooner or later, in the cases about to become fatal, the temperature falls more or less below the normal range, being lower in the morning than in the evening, and even then it mostly fails to attain a normal standard. Towards the end of a fatal case the temperature is apt to rise. The febrile condition is more marked in some cases, and it may be studied upon the detailed charts and cases given in the Appendix A. In several cases of very short duration, where the child is rapidly prostrated with deluging watery stools, the temperature falls rapidly, and the child may die in collapse. The quantity of *urine* voided is naturally reduced by the diarrhœa: the actual extent of the reduction is not of easy determination in young infants; but it is clear that there is a marked diminution of the water excreted by the kidneys. Actual suppression certainly occurs towards the close of some cases. There is *loss of flesh*

Vomiting.

Convulsions.

Coma.

Temperature.

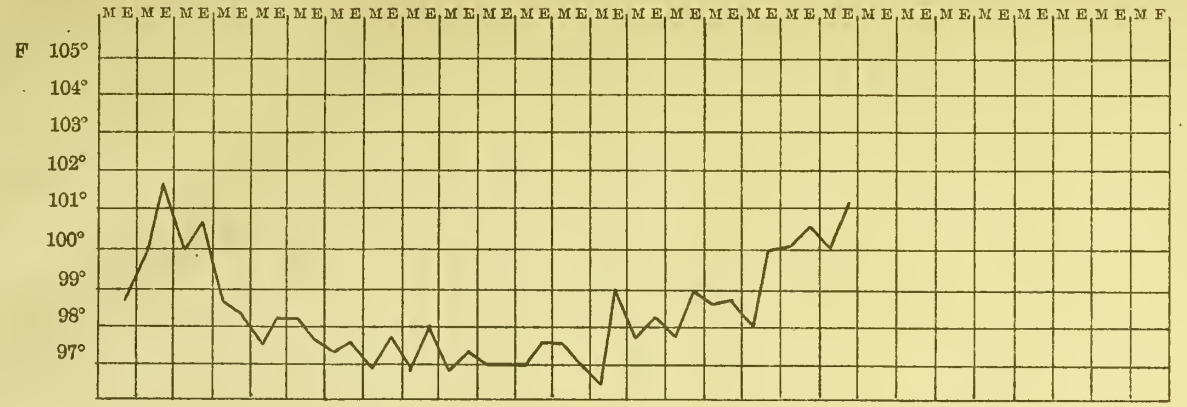
Urine.

Emaciation, &c.

* Other more detailed temperature charts will be found at the end of the Appendix to this report.

CASE IX. *P 85.*

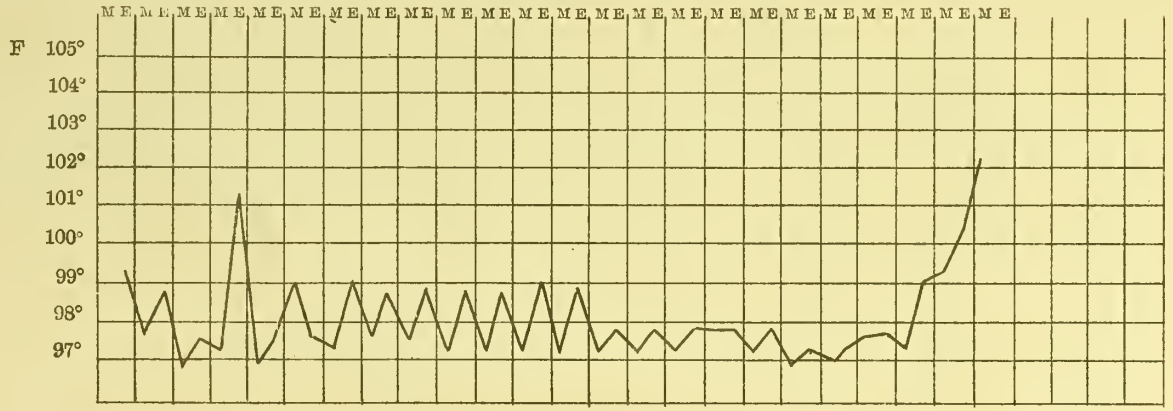
July 14 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. Aug. 1. 2.



Birmingham Children's Hospital.—Lottie Wilkins, æt. 1 yr. 6 mos. Vomited "black stuff" on night of July 12, 1881, followed by moderate but frequent Diarrhœa, all day of 13th. Admitted on 14th. Stools very frequent, passed in small quantities at a time and neutral reaction. Pulse 140. Resp. 24. Some pulmonary râles posteriorly. July 16, Stools became acid; 12 in 24 hours. 19th, 7 motions in 24 hours, slightly acid and a little blood. Pulse 120, very weak. 26th, only 3 motions in 24 hours, and no blood; Vomited; Pulse very weak. 28th, slight dulness and fine crepitant râles both sides posteriorly & some harsh bronchial breathing at right base. Diarrhœa continued to the last, 5 to 8 motions daily. Died 3 a.m. Aug. 3.

CASE VII. *P. 82.*

July 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. Aug. 1. 2. 3. 4. 5. 6. 7. 8. 9.

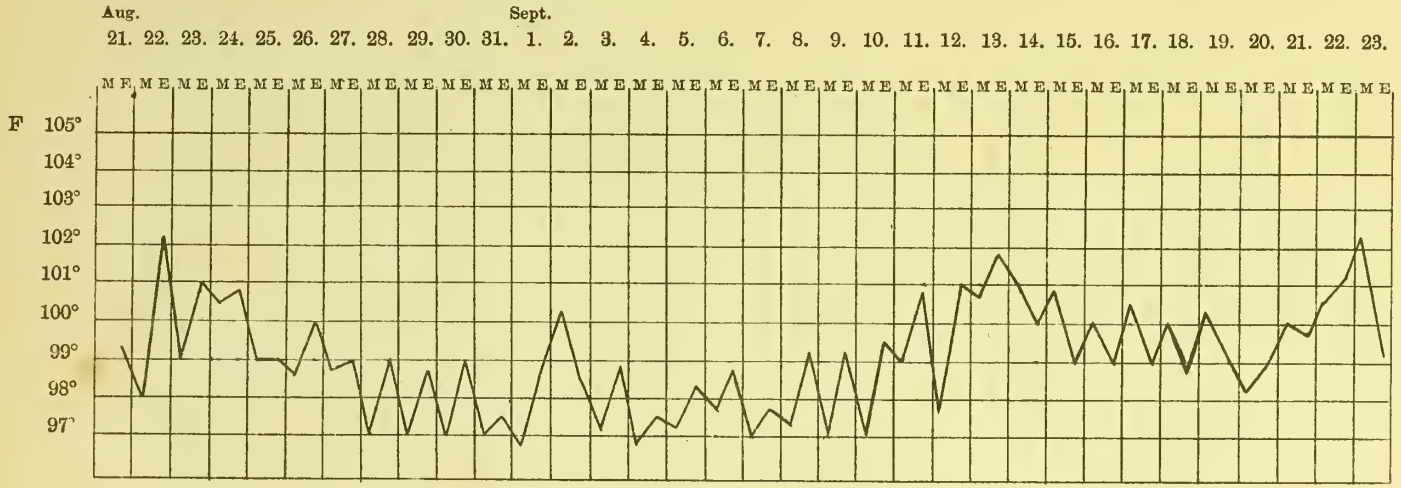


Birmingham Children's Hospital.—Alfred H. Gidney, æt. 1 yr. 2 wks., a healthy strong child, suddenly attacked with Vomiting and Diarrhœa at 11.30 a.m., July 15, 1882, continuing at intervals until admission on evening of 17th. Had 5 stools that day, yellow, semi-liquid, reaction acid. Pulse 120. Resp. 44. There were 11 stools on 20th, 8 on 23rd, otherwise 2 to 5 per diem until Aug. 4th, when they increased to 9 to 11 per diem until death. Vomiting continued at intervals. On Aug. 8th persisted in kicking off the bed clothes. Died at noon Aug. 9.

DANGERFIELD. LITH. 22. BEDFORD ST. COVENT GARDEN 15993. 4/88.

to face page 16.

CASE XI . *P. 86* .



Birmingham Children's Hospital.—Frederick Powell, æt. 14 months. Sudden Vomiting in fairly healthy child, followed, after taking a "teething powder," by frequent purging, stools watery, containing blood and slime. Admitted Aug. 21, 1882, having passed 7 motions during the day acid reaction. Slight cough. Continued in much same condition up to 26th, when child looked better, and stools were green but free from blood. Appeared to be improving, stools being more consistent, and gaining in strength up to Sept. 20, when stools again became frequent and watery; they increased in number and became very watery and offensive up to 23rd, when Died.

DANGERFIELD, LITH. 22, BEDFORD ST. COVENT GARDEN. 15993.4/88.

and weight, sometimes rapid, during the illness. In a report by Dr. Cash upon some chemical observations made upon a few cases admitted into the Leicester Infirmary, which report is given in full in Appendix B. to this report, he states that he found that the total quantity of nitrogen passing away by the fæces is considerably increased. He attributes the chief source of this nitrogen to unabsorbed ingesta, to excretion of albumen, and probably also to excretion of small quantities of urea, which substance he found in some instances in fæces most carefully collected so as to avoid all chance of admixture with urine. He states that the excretion of urea by the kidneys is not markedly increased, and in some instances appears distinctly diminished. Reasoning from such data as he had, the total nitrogenous excretion was found to be increased relatively to the total nitrogenous ingestion. Certain amounts of albumen were recognised in almost all the samples of urine examined.

Causation of "Diarrhœa," by Dr. Ballard.

Chemical conditions of excreta.

I have in Appendix C. to this Report given in detail the characteristic features of 340 fatal cases of the malady observed in Leicester during the epidemic seasons of 1881 and 1882, grouping the cases according as they varied in their degree of acuteness.

All the observations summarised above were made upon fatal cases of so-called "diarrhœa" occurring in the summer. But cases clinically identical with them occur at other seasons of the year, cases even as rapidly fatal and quite as acute as the most acute of those met with in the summer. There is not a week in any year in which deaths from "diarrhœa" (again I say not distinguishable clinically from such as is observed in the summer) are not recorded by the Registrar-General. But in the summer the malady is so common as to constitute *an epidemic of yearly occurrence*. As a disorder, it is not confined to any period of life, and is met with as everybody knows in various degrees of severity, from that of a trifling ailment to that of a serious disorder compromising life.

Fatal "diarrhœa" not confined to summer season.

The main object of this inquiry is to elucidate the circumstances which cause the high mortality which "diarrhœa" occasions in this country, especially in the summer quarter of the year, circumstances which are suspected to have to do with unwholesome conditions of life capable of amelioration or of removal. But before we can possibly be in a position to discuss the influence of these unwholesome conditions, it is essential that as clear and precise a notion as is practicable should be obtained of the epidemic laws of the malady, fatal or non-fatal, as it affects various classes of society, persons of different ages residing in localities of different soils, elevations, &c., and how its prevalence and fatality are affected by season, climate, and other conditions not under human control. It is with general considerations of this nature that the rest of this report will be mainly concerned.

Preliminary investigations requisite.

V.—Nosology.

Nosology.

It is obvious, from all that has preceded, that this malady, which we designate as "diarrhœa," is not a mere dyspepsia, nor a mere enteritis, although enteritis is one element in the disorder, but a *general disease* of specific character, to which a distinct and specific name, other than "diarrhœa" (the name of only one symptom of the disease) ought to be attached. The nervous system and the alimentary system, sometimes the one, sometimes the other, are the systems which show the earliest clinical manifestations of the operation of any specific contagium. Pathological investigation has demonstrated that in fatal infantile diarrhœa the kidney is implicated in the mischief at a period quite as early as the intestinal canal, and that the lesions of this organ are quite as severe in their kind as those of the intestine. In fact "diarrhœa" has just as much or as little right to be regarded primarily as a kidney disease as it has to be regarded primarily as an intestinal disease. Indeed, looking at what pathology teaches us, at the prodromata, at the usually early occurrence of vomiting, and now and then the early occurrence of convulsions, we might be disposed to regard the malady as due rather to kidney than to intestinal affection; but, obviously, the serious pathological changes in the other viscera besides kidney and intestine import more than this. The pneumonia often discoverable when looked for during life, and so commonly manifested on post-mortem examination, may of course in some cases be the result of the direct operation of the morbid contagium, although the fact of its frequently late discovery seems to indicate that it is of secondary origin. The invariable fatty degeneration of the liver which commences at the earliest period of the malady and becomes more and more pronounced as the disorder progresses, reminds one for the moment of the operation of at least one chemical poison—phosphorus.

"Diarrhœa" a general disease.

Causation of "Diarrhœa," by Dr. Ballard.

Properly classified with eruptive fevers.

The Royal College of Physicians of London, in their "Nomenclature of Diseases," classify epidemic diarrhœa among "General Diseases," placing it in Group A. of these diseases, viz., among "Diseases dependent on Morbid Poisons," and in the same sub-group as the well-known eruptive fevers, small-pox, scarlet fever, enteric fever, &c., in which sub-group the College also places malignant cholera. If any justification of this classification be needed, it will be found in the general issue of that part of my inquiry with which this report is concerned. The affinities of the malady are most assuredly with the diseases among which the College has grouped it. As in scarlet fever, so in "Diarrhœa" the condition of the kidney is an essential element in the disorder, and the uræmia observable in the one disease finds its analogue in the other. From this view-point the intestinal lesions in diarrhœa may be but the analogue of the skin eruption in scarlatina.* That the one disease is notoriously communicable from one person to another, while the other is usually regarded as non-communicable, goes for little as an argument against such analogy, since on the one hand very many outbreaks of scarlatina (namely, those of milk origin) seem to have hardly any such communicable quality, and on the other hand communicability is a quality not unknown among cases of epidemic diarrhœa. In both diseases it is from the cutaneous or quasi-cutaneous (mucous) surface chiefly implicated that the contagious principle gets abroad, viz., the skin and throat surfaces in scarlatina and the intestinal mucous surface in "diarrhœa." In proof of the occasional communicability of an epidemic diarrhœa, I place in the Appendix to this Report (Appendix H.) a report by Dr. Low, on several occurrences of the sort which were very carefully observed by him when filling the post of medical officer of health in the rural district of Helmsley, in Yorkshire. Other apparent occurrences of this kind have come to my knowledge, but this is not the place to consider the subject further. The kinship of "Diarrhœa" to malignant cholera is seen principally in the fact that both are clinically diarrhœal diseases, in which the abundant watery discharges from the bowels are more or less rapidly succeeded by collapse, in which there is some similarity (in diarrhœal cases about to become fatal), in the *facies*, the sunken eyes, the shrinking of the bulk of the body, and algidity in certain cases.† In both there is free desquamation of the intestinal epithelium; in both the kidneys are early implicated, and in both this condition may issue in uræmia and its results. Communicability through the medium of the morbid evacuations, although reputedly a character of malignant cholera, does not appear to be a character uniformly attaching to the disease, nor is non-communicability through the same medium a character invariably attaching to the epidemic diarrhœal malady.

Fatal diarrhœa.

VI.—Fatal Diarrhœa.

(*a*) *Duration of the Malady in Fatal Cases.*‡

Duration of fatal malady.

Diarrhœa exhibits very various grades of intensity in persons dying of the disease. It may be fatal in a few hours or it may linger on in the way that has been pointed out in the Appendix to this Report for a period of three, four, or even six or eight weeks.

The investigation which Mr. Power and I carried out in Leicester during the epidemic season of 1881 and 1882 enables me to give some precision to this statement. The results of the inquiry, so far as it related to this point, are given in Table XII., the instruction derivable from which I now proceed to educe.

Generally then, it may be observed that out of the 340 fatal cases of *Infantile* diarrhœa inquired into—

169, or about a half of them, were fatal in less than one week.

90, „ „ a quarter, „ „ between one and two weeks.

29, or between an eighth and ninth of them, were fatal before the end of the third week from the commencement of the illness.

---

* It may be perhaps worth suggesting that careful daily examination of the cutaneous surface in cases of infantile diarrhœa, such as at present is not habitually made by observers, may some day lead to discovery of a distinctive, although evanescent, rash in this disease, just as a similar careful examination discovered some years ago the distinctive rash of enteric fever. Diarrhœa is not an uncommon *prodroma* of scarlet fever, especially in some local epidemics, although vomiting is more usual.

† The temperature charts given after the Appendix to this Report may be compared with those of cases of malignant cholera published by Sir John Simon, then Medical Officer of the Privy Council, in his Ninth Annual Report (for 1866).

‡ See also p. 44.

There was a residue of 52, or 15 per cent., whose illness was in one way or another protracted beyond the last-named period.

As a fact, 53·3 per cent. of all the cases were fatal in a period between 4 days and 14 days.

Causation of "Diarrhœa," by Dr. Ballard.

(*b.*) *Duration of Illness in Fatal Cases in relation to Epidemicity of the Disease.*

Duration of fatal illness is one test of the severity of the malady. It will be useful then to inquire whether, looked at in this light, the severity of the malady varies with the stage of the epidemic.

Varies with stage of epidemic.

Table XIII. (p. 73) enables us to do this. In this table I have arranged for each year of the inquiry at Leicester the duration of the fatal cases that had their commencement in each week of the epidemic season, and have placed together the data of 1881 and 1882 in such a way as to show any correspondence or the reverse that can thus be made apparent. In comparing the two years it is to be observed that the epidemic season of 1881 was of shorter duration than that of 1882: and it is to be kept in mind that I am dealing with severe cases of diarrhœa, so severe as to be fatal, and that, therefore, the figures given are indicative only of degrees of ferocity of the malady when its ferocity is manifested by the time it takes in killing its victim.

The 1881 epidemic fatal cases commenced (their illnesses commenced) in the 27th week of the year, and there were but few fatal cases whose illnesses commenced after the 33rd week. Putting these in the order of weeks, then, we find each week's and each fortnight's *per-centage* of all the cases of each duration specified in the following Table:—

Week of Commencement of Illness.	Duration in Weeks.			
	Under 1 Week.	1 and under 2 Weeks.	2 and under 3 Weeks.	3 Weeks and upwards.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Of 8 cases commencing on the 1st of the 10 weeks	0·0	62·5	12·5	25·0
Of 21 cases commencing on the 2nd of the 10 weeks	43·1	23·8	4·8	28·6
	31·0	34·5	6·9	27·6
			34·5	
Of 40 cases commenced on the 3rd of the 10 weeks	52·5	35·0	—	12·5
Of 25 cases commenced on the 4th of the 10 weeks	52·0	24·0	20·0	4·0
	52·3	30·8	7·7	9·2
			16·9	
Of 33 cases commenced on the 5th of the 10 weeks	39·4	39·3	9·1	12·1
Of 15 cases commenced on the 6th of the 10 weeks	46·1	40·0	13·3	—
	41·7	39·6	10·4	8·3
			18·7	
Of 9 cases commenced on the 7th of the 10 weeks	100·0	—	—	—
Of 3 cases commenced on the 8th of the 10 weeks	66·7	33·3	—	—
	91·6	8·3	—	—
			—	
Of 0 cases commenced on the 9th of the 10 weeks	—	—	—	—
Of 4 cases commenced on the 10th of the 10 weeks	100·0	—	—	—
	100	—	—	—
			—	

The 1882 epidemic fatal cases commenced (their illnesses commenced) in the 26th week of the year, and there were few fatal cases whose illnesses commenced after

Causation of "Diarrhœa," by Dr. Ballard.

the 33rd week. Putting these similarly in order of weeks, the result is represented in the following Table :—

Week of Commencement of Illness.	Duration in Weeks.			
	Under 1 Week.	1 and under 2 Weeks.	2 and under 3 Weeks.	3 Weeks and upwards.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Of 8 cases commencing on the 1st of the 10 weeks	37·5	12·5	12·5	37·5
Of 25 cases commencing on the 2nd of the 10 weeks	32·0	44·0	—	24·0
	33·3	36·4	3·0	27·3
			30·3	
Of 16 cases commencing on the 3rd of the 10 weeks	43·7	12·5	6·2	37·5
Of 27 cases commencing on the 4th of the 10 weeks	37·0	22·2	29·6	11·1
	39·5	18·6	20·9	20·9
			41·8	
Of 16 cases commencing on the 5th of the 10 weeks	56·2	12·5	18·7	12·5
Of 19 cases commencing on the 6th of the 10 weeks	52·6	31·6	5·3	10 5
	54·3	22·9	11·4	11·4
			22·9	
Of 18 cases commencing on the 7th of the 10 weeks	72·2	16·7	—	11·1
Of 13 cases commencing on the 8th of the 10 weeks	53·8	38·5	—	7·7
	64·5	25·8	—	9·7
			9·7	
Of 13 cases commencing on the 9th of the 10 weeks	76·9	15·4	—	7·7
Of 6 cases commencing on the 10th of the 10 weeks	66·7	16·6	—	16·6
	73·7	15·8	—	10·5
			10·5	
Of 9 cases commencing on the 11th of the 10 weeks	66·7	11·1	22·2	—
Of 4 cases commencing on the 12th of the 10 weeks	100·0	—	—	—
	76·9	7·7	15·4	—
			15·4	

These tables teach us mainly three things. 1. That the severity of diarrhœa, as thus measured, may be very different in different years. It is to be noted that there was not any great difference in the number of the fatal cases in the two years, viz., 158 in 1881 and 174 in 1882, the epidemic being, however, more protracted in the latter than in the former year. 2. That its severity (again as measured in this way) or what we may term the ferocity of the malady (as shown by the time it takes to kill its destined victim), appears to be least at the outbreak of the epidemic season (and it is only the epidemic season I am now dealing with), and to increase as the season advances up to its close. 3. That this increase in ferocity is not a steady increase week by week, but an increase with occasional slight abatements; indeed, the decrease and increase seem to occur in *waves*.

"Ferocity" increases as epidemic season advances.

Looking now at Table XIII. (p. 73), so far only as it shows the several short durations under one week, this tendency to increased ferocity of onslaught (or to lessening resistance to it on the part of destined victims) is again very strikingly obvious.

But the question naturally arises whether the above results may not be due to the age of the victims at the several periods of these two epidemics. To assist in the solution of this question I have constructed Tables XIV. and XV. (pp. 74, 75, and 76).

Causation of "Diarrhœa," by Dr. Ballard.

(*c.*) *Duration of Illness in Fatal Cases in Relation to Age.*

An analysis of Tables XIV. and XV. gives facts as follows:—

Duration in relation to age.

Duration of Fatal Illness.	0–1 Years.		1–5 Years.	
	Deaths.	Rate per 1,000 living at Age	Deaths.	Rate per 1,000 living at Age
Less than 7 days - -	150	38·1	19	1·4
7 to 14 days - - -	85	21·6	5	0·4
14 days and upwards - -	74	18·8	7	0·5
Totals - -	309	78·5	31	2·3

Children over one year old seldom die except when attack is "ferocious."

There is here pretty clear indication of a well known fact, namely, that fatal diarrhœa is vastly more common among infants than among other persons. But also it is seen that among babies, quickly fatal diarrhœa, and diarrhœa more deliberate in its fatal tendency, are about equally common, whereas among older children quickly fatal diarrhœa is much more common than fatal diarrhœa of the other sort. This can only mean that children over 12 months of age are much better able than babies to resist diarrhœa; that in fact older children seldom die except of very acute attack, whereas infants die almost indifferently whether their attack be sudden and acute or slow and protracted. The period, therefore, of an epidemic at which children 1–5 years of age die in greatest abundance must needs be the stage of its greatest virulence, and a means is thus afforded of testing the validity of the inference that the ferocity of diarrhœa increases as the diarrhœa season advances.

Let us then inquire whether in Leicester children 1–5 years of age were most prone to die of diarrhœa at the stage of the epidemic in which acute cases generally were most abundant.

Taking the epidemic season of 1881 in five consecutive fortnightly periods, we find the order from least to greatest acuteness (*i.e.* of those dying under one week) to be—1st, 3rd, 2nd, 4th, and 5th fortnights.

Was this the order in fortnightly periods of those dying over 1 year of age? from least to greatest—

Number of those over 1 *Year of Age.*

In 1st fortnightly period	2	or	6 · 9	per cent.	of all cases in this period.
„ 2nd „	2	„	3 · 1	„	„ „
„ 3rd „	5	„	10 · 4	„	„ „
„ 4th „	2	„	16 · 7	„	„ „
„ 5th „	1	„	25 · 0	„	„ „

The order is 2nd, 1st, 3rd, 4th, and 5th. In both series the smallest per-centages are found, on the whole, in the earlier periods, and the largest in the later periods; and there is the like indication of waves of ferocity (*see* p. 20).

Studying the epidemic season of 1882 in the same way:—The order from least to greatest acuteness is a completely consecutive one, viz.:—1st, 2nd, 3rd, 4th, and 5th fortnights.

Number of those over 1 *Year of Age.*

In 1st fortnightly period	2	or	6 · 1	per cent.	of all cases in this period.
„ 2nd „	4	„	9 · 3	„	„ „
„ 3rd „	5	„	14 · 3	„	„ „
„ 4th „	4	„	12 · 9	„	„ „
„ 5th „	3	„	15 · 8	„	„ „
„ 6th „	1	„	7 · 7	„	„ „

Again in both series the smallest per-centages are found, on the whole, in the earlier, and the largest in the later periods (with the exception of the last fortnight); and there are the like indications of waves of ferocity (*see* p. 20).*

* The fact that there were no children in 1881 and very few in 1882 dying of lingering illness at the later stages of the epidemic is capable of explanation on a hypothesis of sudden reduction in the amount of the material cause of the diarrhœa taking place at late periods of an epidemic season, so that there is then less opportunity of any given child getting repeated doses of the poison and suffering from their cumulative effects.

Causation of "Diarrhœa," by Dr. Ballard.

VII.—Attack by "Diarrhœa."

(*a.*) *Sources of Data.*

Attack by diarrhœa.

Sources of data.

Old Islington records.

1. During the years that I filled the post of medical officer of health in Islington, I kept a weekly record of all fresh cases of *sickness*, and specially of certain forms of zymotic disease, that occurred newly in the poor law practice, and in the practice of various institutions for the relief of the sick poor;* and during six of these years I kept a record of the ages of those who sought relief from "zymotic" sicknesses, and among the latter from what is called "diarrhœa." From these records I have constructed certain tables (Tables I. to V., pp. 47–57) and charts (III., IV., and V., at end of report) to which I shall refer.

Leicester arrangements.

2. During the epidemic season of 1880, the town council of Leicester, with a view to affording speedy and gratuitous relief to those sick with the malady, distributed from one place in the borough to all applicants a "diarrhœal mixture," taking down in a book the names, ages, and residences of the applicants, or of those at their houses, who, being sick, required the medicine. When I commenced my inquiry in the diarrhœal season of 1881, I induced the town council to establish five such places instead of one, so as to increase the facilities for supplying the sick, and, by a careful selection of the localities, to enable me to gather more uniformly over the borough certain information about the disease, that I thought it well that I should have. I have made an analysis of the records thus obtained, and this analysis also I propose to utilise here. Out of these records, Table VI. (pp. 58–64) has been constructed. They differ from the Islington records chiefly in that they relate, not to the prevalence of diarrhœa throughout the year, but only to its prevalence during the epidemic season. The information they furnish would have been more complete had the stations established by the Leicester Sanitary Authority for the supply of medicine to the population been opened in each year at a sufficiently early period, that is, either before the epidemic outbreak or immediately at its commencement. But it will be seen by the table that this was not the case. The table relates to seven years, 1881 to 1887, and of these I have only complete records of the whole epidemic season for the years 1883 and 1887. Of the seven years, three were years of comparatively high epidemic prevalence of the malady, viz., 1884, 1886, and 1887, and four were years of comparatively low epidemic prevalence, viz., 1881, 1882, 1883, and 1885.

Records made by medical practitioners.

3. Furthermore, at the commencement of the inquiry, recognising the importance of information not as yet anywhere recorded, as to the circumstances under which non-fatal as well as fatal diarrhœal sickness occurred in different classes of the community, I took steps to make known throughout the profession my wants in this respect—by the medium of the medical journals and by personal communication with medical friends. And I invoked the assistance of others not previously personally known to me, at meetings of medical practitioners that I attended for the purpose. In addition, I prepared and issued to such as declared themselves willing to use them, convenient forms for recording a certain few defined observations at the time of their being made.

These various appeals, public and private, were responded to by over 130 medical practitioners in various parts of the country, whom I succeeded apparently for the moment in interesting in this section of my work. My expectation of help in this direction was, however, doomed very largely to disappointment. Many of those who undertook to make the records I desired of them appear to have at once forgotten their promises, others misunderstood the instructions they received, and others again, having commenced to make records of their cases and to forward them to me, sooner or later abandoned the practice—no doubt partly because their assistance was asked during a season when medical men are likely to be especially busy with their daily practical work. The result of my appeals was thus insignificant when compared with that which I was rash enough to anticipate and was prepared to deal with laboriously.

The gentlemen who persisted longest in these observations and made them most completely and accurately were my present colleague, Dr. Bruce Low, then medical officer of health at Helmsley in Yorkshire, Dr. Birt of Stourbridge (who, however, confined his observations to infants), both unfortunately having only limited spheres of observation, and Dr. H. M. Page, of Redditch, who had recently resigned the post of medical officer of health for that town. To this last-mentioned observer the Board is under a special obligation; for not only did he record in the way I desired, during a protracted period of $6\frac{1}{2}$ years, no fewer than 1,497 cases of "diarrhœa" at all ages,

Dr. H. M. Page's Redditch observations.

* It is the same record as that which furnished the materials for a paper which the Medical Officer of the Privy Council did me the honour to publish in his eleventh annual report.

which occurred in his private and club practice, but, having already for some time kept up meteorological observations at Redditch, he added at my request and at his own cost to his other instruments a pair of earth thermometers, and placed at my disposal, for the purpose of the inquiry, the whole of his carefully made observations.* Causation of "Diarrhœa," by Dr. Ballard.

4. I have availed myself of the information contained in tables of admissions and results of treatment furnished in the published annual reports of two hospitals for sick children, each of which has an out-patient and in-patient department, namely, the Manchester Hospital and Dispensary for Sick Children and the Children's Hospital in Great Ormond Street, London. Unfortunately these published tables are not drawn up on the same plan, so that in some important respects they are not comparable; and, moreover, the two institutions differ in this, viz., that the Manchester institution is free to all comers, and is generally known to be so by those likely to resort to it; whereas the admissions to the benefits of the London institution are professedly gained by recommendations from subscribers. This, indeed, is commonly understood, although, as a fact, the system of "recommendation," as respects the out-patient department, is not strictly adhered to; but belief in it clearly has an influence upon the admissions which must be kept in mind when using the figures of the tables. In both institutions, however, the cases for admission as in-patients are selected from the out-patient department at the discretion of the medical staff. Children's Hospitals.

I proceed, therefore, now, under distinct headings, to discuss certain points which the materials I have derived from these several sources enable me to deal with more or less satisfactorily to my own mind.

Tables I. to XI. (pp. 47–70), constructed from these materials, are those which I propose to use, and to which I shall refer in the course of the immediately succeeding remarks and inferences.

(*b.*) *Age in Relation to Attack.*

Age in relation to attack.

The actual incidence upon age (*by which term wherever it is used is signified relation to the population living at the several ages*) *is chiefly upon children under five years of age, and of these most upon those under two years.*

Incidence of malady greatest on children.

After five years of age the actual incidence lessens remarkably, and is least betweeen the ages of five and 25 *years, after which age it gradually increases.*

Among children under five years of age the incidence is comparatively small upon those under three months, after which age apparently it increases ; beginning to lessen somewhere between the ages 1–2 *years.*

Islington observations.

Table IV. (p. 51) records in detail the age of 4,516 cases of diarrhœa newly occurring in the poor law practice of the parish of Islington during the whole course of the six years 1857, 1858, 1859, 1860, 1861, and 1862; of these there were:—

Under one year of age	- -	682 = 15·1 per cent. of total.
One year and under five years	-	1,451 = 32·1 „
Five years and upwards	- -	2,383 = 52·8 „

Rather more than half the cases then were in persons over five years of age. Of the 2,133 under five years as many as 68 per cent. were one year old and upwards.

But to gain a proper notion of the incidence of the malady upon persons of different ages the numbers living at the several ages must be taken into account. In Islington, the relative numbers living at different periods of life in each of the years 1857 to 1862 was probably not very different from what was observed in the Census year 1861, so that for my present purpose it may suffice to use the figures of the Census table for that year with which to compare the number of cases at different ages. The following is the result of the comparison:—

—	Years of Age.													
	Under 1.	1—	2—	3—	4—	Under 5.	5—	10—	15—	25—	35—	45—	55—	65 and upwards.
Popn. Census 1861 -	4,788	4,116	4,143	3,953	3,833	20,833	17,051	14,252	30,937	26,787	19,949	9,747	7,763	5,022
Cases 1857 to 1862 -	682	769	357	211	114	2,133	281	202	286	497	447	307	200	163
„ per 1000 of above Popn.	142·5	186·8	86·7	53·4	29·6	102·4	16·5	14·2	9·2	18·6	22·4	31·5	25·8	32·5

* One illustrative chart, out of those I have constructed from Dr. Page's observations, is introduced at the end of this report (Chart VI.).

Causation of "Diarrhœa," by Dr. Ballard.

This shows how vastly greater was the incidence of the malady upon children under five years of age than upon persons over that age; and further it shows that, whereas the incidence, small as it is comparatively, lessened gradually from five years up to 25 years, it then doubled for the next decade and increased up to old age, but even then was less than half what it was under five years. There is, however, an anomaly in the series (age 45–55) which I cannot explain.

The incidence described as falling so remarkably upon ages under five years was in fact mainly upon the first two years of infant life. It is noteworthy that, of these two years, the actual incidence on the age one to two years was higher than that on the ages under one year.

Table I. (p. 47) also gives for the six years some details of the number of cases that occurred in the four tri-monthly periods of the first year of life:

Under 3 months of age	-	92 cases	= 13·5 per cent. of total.
Over 3 months and under 6 months	-	212 „	= 31·1 „
„ 6 „ „ 9 „	-	211 „	= 31·0 „
„ 9 „ „ 1 year	-	167* „	= 24·4 „

These figures are very interesting and have a bearing which will be discussed in its proper place, upon the etiology of the malady. It will suffice to point out here that, although the numbers living at the second and third of the above age-periods must have been smaller than those living at the first of the age-periods, the number of cases observed in both the second and third of the periods was more than twice as numerous as those observed in infants under three months of age, while the number in the fourth period was nearly (probably quite*) twice as numerous.

Redditch observations.

The figures derivable from Dr. Page's records during 6½ years at Redditch, embracing as they do all periods of the year, are, of those that I possess, most comparable with the Islington figures, although the total of cases recorded only amounts to 1,497, Redditch being a small artizan town with only 9,961 population in 1881. Of these 1,497 cases there were—

Under one year of age	-	216	= 14·4 per cent. of total.
One year and under five years	-	412	= 27·5 „
Five years and upwards	-	869	= 58·8 „

The proportions are not very different from those of the Islington cases.

The Census tables of 1881 (into which has been most usefully introduced tables of ages of the population in the several sanitary districts in England and Wales) enable me to give the following table of actual incidence of Dr. Page's cases of the malady upon age in Redditch which may be compared with the Islington table given above.

	Years of Age.										
	Under 1 Year.	1—	2—	1 and under 5 Years.	Under 5 Years.	5—	25—	45—	65 and upwds.	5 Years and upwds.	Total All Ages.
Population of Urban Sanitary District of Redditch, 1881 -	322	278	814	1,092	1,414	4,202	2,506	1,386	433	8,547	9,961
Dr. Page's Cases, 1881 to 1887 -	216	178	234	412	628	272	323	214	60	869	1,497
Cases per 1,000 Population, 1881	671	640	287	377	444	65	129	154	132	102	150

On the whole this is not inconsistent with the Islington table in the matter of incidence upon age. There is a discrepancy, however, between the two tables in respect of actual incidence upon ages 65 and upwards, probably due to a difference in the nature of the practices from which the two series of cases were derived. In Redditch, too, it would appear that during recent years the incidence upon the age of one to two years was less than it was upon ages under one year; the reverse was the case apparently in Islington 30 years ago (but see *infra* and note *).

* It is probable that the figure 167 is an under-statement of the truth; and that the figure given in Table I. for the cases under one year is consequently a similar under-statement. If it be so, then the figure for one and under two years is over-stated. My reason for this opinion is, that in such a practice as furnished the figures it is likely that neither the mother nor the medical man who treated the case (when the importance of accuracy was not obvious) would be very particular or precise in their statement of an age near *about* one year, so that infants of 10 or 11 months might have come to be entered as one year old.

Causation of "Diarrhœa," by Dr. Ballard.

The disturbance of the series of increasing actual incidence as age advances over five years, caused by excessive incidence on ages 45 to 65 is to be noted.

Of Dr. Page's 216 cases the numbers that were met with in the four tri-monthly periods of the first year of life were—

Under 3 months - - -	37 cases	= 17·1	per cent. of total.
Over 3 months and under 6 months -	57 „	= 26·4	„
„ 6 „ „ 9 „ -	62 „	= 28·7	„
„ 9 „ „ 1 year -	60 „	= 27·8	„

Again, a considerable similarity to Islington lies in this, viz., that the number of cases occurring at ages under three months was smaller than at any of the subsequent ages (although not comparatively so small as represented by the Islington figures), and that the numbers at the next two periods of age are nearly the same, while the number 60 against the age nine months to one year confirms the suspicion expressed in the note appended to the Islington figures on p. 24.

The following little tables may also be compared with various Islington tables in Appendix.

Ages of Dr. Page's Cases in Redditch.

Years.	Diarrhœa Attacks at Ages.														
	Months.				Years.										
	0–	3–	6–	9–	Under 1.	1–	2–	4 and under 5.	Under 5.	5–	25–	45–	65 and upwds.	5 Years and upwds.	Total All Ages.
1881* - -	7	8	3	4	22	17	32	49	71	14	19	9	2	44	115
1882 - -	5	2	3	6	16	21	31	52	68	23	17	16	4	60	128
1883 - -	3	9	21	13	46	35	42	77	123	38	37	42	10	127	250
1884 - -	3	10	17	10	40	38	28	66	106	58	73	54	6	191	297
1885 - -	8	9	6	12	35	23	33	56	91	36	47	31	16	130	221
1886 - -	5	8	3	6	22	25	36	61	83	51	45	34	13	143	226
1887 - -	6	11	9	9	35	19	32	51	86	52	85	28	9	174	260
Whole 6 years -	37	57	62	60	216	178	234	412	628	272	323	214	60	869	1,497

* The record for this year only commenced with the 25th week of the year. What later on in the report I designate the "Pre-epidemic period," together with the four first weeks of the "Epidemic period," are wanting.

Actual Incidence on Redditch Population at different Ages, during Six complete Years.

Years.	Population.					Cases of Diarrhœa.									
						Under 1 Year.		1 and under 5 Years.		Under 5 Years.		5 Years and upwards.		All Ages.	
	Under 1 Year.	1 and under 5 Years.	Under 5 Years.	5 Years and upwards.	All Ages.	Number.	Per 1,000 Population.	Number.	Per 1,000 Population.	Number.	Per 1,000 Population.	Number.	Per 1,000 Population.	Number.	Per 1,000 Population.
1881 Census - -	322	1,092	1,414	8,547	9,961	22	—	49	—	71	—	44	—	115	—
Estimated Population. 1882	327	1,125	1,452	8,777	10,229	16	48·9	52	46·2	68	46·8	60	6·8	128	12·5
1883	336	1,155	1,491	9,006	10,497	46	136·9	77	66·7	123	82·5	127	14·1	250	23·8
1884	344	1,184	1,528	9,237	10,765	40	116·3	66	55·7	106	69·4	191	20·7	297	27·6
1885	353	1,214	1,567	9,466	11,033	35	99·1	56	46·1	91	58·1	130	13·7	221	20·0
1886	362	1,243	1,605	9,698	11,303	22	60·8	61	49·1	83	51·7	143	14·7	226	20·0
1887	370	1,273	1,643	9,926	11,569	35	94·3	51	40·1	86	52·3	174	17·5	260	22·5
Means of 6 Years 1882-87 - -	349	1,199	1,548	9,351	10,899	32	91·7	60	50·0	93	60·1	137	14·7	230	21·1

Leicester observations.

The numbers derivable from my Leicester records are less fairly comparable with the above for Islington and Redditch, inasmuch as they deal only with cases occurring during epidemic seasons and collected under peculiar arrangements; but I may use them for purposes of comparison when this qualification is understood, and with the further explanation that I shall give presently.

Causation of "Diarrhœa," by Dr. Ballard.

Among the 44,678 cases recorded in Leicester during the seven epidemic seasons of 1881–87 and tabulated in Table VI. (pp. 58–64) there were—

Under 1 year of age -	-	2,284 cases =	5·2 per cent. of total.
1 year and under 5 years	-	8,956 „ =	20·0 „
5 years and upwards -	-	33,438 „ =	74·8 „

The following table, which is abstracted from Table VI., will show the incidence of these cases upon the population of Leicester, and assist in the comparison.

Epidemic Period only.

Years.	Actual Incidence per 10,000 Estimated Population at each Age.				
	Under 1 Year.	1 and under 5 years	Under 5 Years.	5 Years and upwards.	All Ages.
Islington 6 years 1857–62 Summary -	—	—	816·4	140·3	230·5
Leicester - - 1881 -	975	998	993	397	479
„ - - 1882 - -	526	629	604	233	285
„ - - 1883 - -	675	872	829	294	369
„ - - 1884 - -	1,082	1,445	1,364	730	816
„ - - 1885 - -	357	408	392	219	246
„ - - 1886 - -	748	839	819	387	450
„ - - 1887 - -	974	992	987	643	690
	Totals				
	5,337	6,183	5,988	2,903	3,335

It need scarcely be said that no inference is to be drawn from these numbers as to the relative prevalence of the malady in Islington and Leicester, the circumstances under which the cases were gathered having been so very different. All that can be inferred is that a larger proportion of the population of Leicester availed itself of the gratuitous relief given by the Sanitary Authority than that which availed itself of Poor Law medical relief given in Islington. This is in no way surprising. But in estimating the incidence of the malady upon different ages, the Islington numbers are most to be relied upon when comparing the incidence upon ages under and over five years. And for this reason, namely, that the Islington poor law practice from which the numbers were gathered was more of the nature of a "family practice," but among a destitute class of persons; whereas, under the Leicester arrangement, probably a large number of grown-up persons attacked with the malady, or finding it get worse while at their work, looked in at the stations (which would be convenient for any of them) to obtain some doses of medicine on their way home, or in the intervals of their work. This will probably account for the difference between 52·8 in Islington and 74·8 in Leicester, as respects the proportional incidence on those over five years of age.

There is some proof of this in the fact that in the list of cases occuring during the epidemic season of 1881 in the practice of three of the medical men in Leicester (Dr. Sloane, Dr. Crossley, and Dr. Emms) I find the numbers at the different ages to have been—

—	Under 1 Year.	1 and under 5 Years.	5 Years and upwards.
Dr. Sloane - -	25	13	29
Dr. Crossley -	12	1	6
Dr. Emms - -	20	12	18

Observations by various medical practitioners.

Probably in Leicester many mothers took their sick infants to private medical practitioners, while the grown-up members of the family found it convenient to get medicine for themselves from the Corporation stations.

The numbers at each age in Dr. Low's series at Helmsley and its neighbourhood, whose practice may be regarded as a typical rural one and carried on in a district

where he was personally acquainted with each individual family and its current medical requirements, were as follows: Altogether he has furnished me with particulars of 249 cases of "diarrhœa" occurring during the four years 1881 to 1884.*

Causation of "Diarrhœa," by Dr. Ballard.

Dr. Low at Helmsley.

Years.	Diarrhœa attacks at Ages.																
	Months.				Years.												
	0–	3–	6–	9–	Under 1.	1–	2–	1 and under 5.	Under 5.	5–	10–	15–	25–	45–	65 and upwards.	5 and upwards.	Total All Ages.
1881 - -	1	2	1	-	4	2	2	4	8	3	3	1	9	4	5	25	33
1882 - -	-	4	2	2	8	2	14	16	24	5	1	1	16	4	4	31	55
1883 - -	3	3	1	1	8	4	17	21	29	5	5	15	33	13	5	76	105
1884 - -	2	-	1	-	3	2	6	8	11	3	2	4	21	11	4	45	56
Totals -	6	9	5	3	23	10	39	49	72	16	11	21	79	32	18	177	249

Actual Incidence on Ages.

—	Diarrhœa attack at Ages.												Total of All Ages.
	Under 1.	1–	2–	1 and under 5.	Under 5.	5–	10–	15–	25–	45–	65 and upwards.	5 and upwards.	
Population of Rural Sanitary District of Helmsley, 1881	166	144	425	569	735	701	703	1205	1243	899	433	5184	5919
Cases per 1,000 of Population at each age - - -	139	69	92	86	98	20	16	17	64	36	41	34	42

Disturbance of the series of increasing incidence as ages advance over 10 years occurred by excessive incidence on ages 25 to 45. In Islington a disturbance was caused by an excessive incidence on ages 45 to 55; in Redditch by a similar excessive incidence on ages 45 to 65.

The following are two series of cases from two widely distant colliery districts, the people living in colliery villages or small towns, and with few exceptions being of the labouring class. In each district the list may be taken as including all or nearly all the cases that required medical treatment.

In two colliery districts.

Name of Observer.	Place and Year.	Diarrhœa attacks at Ages.																
		Months.				Years.												
		0–	3–	6–	9–	Under 1.	1–	2–	1 and under 5.	Under 5.	5–	10–	15–	25–	45–	65 and upwards.	5 and upwards.	Total All Ages.
Dr. Arthur - - -	Wingate, Durham, 1883 - -	1	5	3	1	10	10	18	28	38	7	1	1	4	-	-	13	51
Dr. Sykes - - -	Mexborough, Yorkshire, 1881	4	1	4	3	12	18	10	37	49	1	-	10	31	3	5	50	99
	Both series - - -	5	6	7	4	22	28	37	65	87	8	1	11	35	3	5	63	150

The very high incidence here on those under five years, especially between one and five years, is to be noticed. It contrasts strongly with Helmsley and resembles more closely my old Islington record. There appears also to have been at Mexborough especially a high incidence on those between 25 and 45; but this is a colliery and iron forging district where there is a proportionately large population of labourers at such ages.

* These cases may be taken as being practically *all* that required medical attention among those that occurred in the section of the district assigned to Dr. Low, the population of which was 3,961.

Causation of "Diarrhœa," by Dr. Ballard.

In various other places.

The next series of cases, the ages of which have been supplied to me, is a heterogeneous one from medical gentlemen practising in some towns, manufacturing and other, about the nature of whose clientelle I know nothing:

Name of Observer.	Place.	Diarrhœa attacks at Ages.																Total All Ages.
		Months.				Years.												
		0–	3–	6–	9–	Under 1.	1–	2–	1 and under 5.	Under 5.	5–	10–	15–	25–	45–	65 and upwards.	5 and upwards.	
Mr. W. H. Hughes	Ashton-under-Lyne, 1881	2	3	5	1	11	2	4	6	17	–	–	6	16	8	3	33	50
Dr. Thomson	Luton, 1881	4	3	1	1	9	3	1	4	13	–	–	5	14	5	3	27	40
Dr. Styles	Sheffield, 1881	–	1	2	–	3	3	1	4	7	–	–	2	5	3	2	12	19
Dr. Bryden	Bristol, 1881	3	3	2	1	9	8	10	18	27	2	–	2	13	4	2	23	50
Dr. Palmer	Loughborough, 1881	3	3	1	–	7	4	1	5	12	–	1	–	4	3	7	15	27
Do.	Do. 1882	–	–	–	–	–	2	1	3	3	–	–	–	–	1	–	1	4
Dr. Lake	Teignmouth, 1881	2	–	–	2	4	4	7	11	15	3	–	2	7	6	8	26	41
Dr. Workman	Reading, 1881	1	1	1	1	4	4	6	10	14	1	3	4	6	3	3	20	34
Do.	Do. 1882	2	2	2	–	6	–	2	2	8	1	–	2	5	1	–	9	17
Mr. Tench	Do. 1881	2	1	–	–	1	–	–	–	1	–	2	1	2	2	–	7	8
Mr. Richardson	Do. 1881	–	1	–	1	4	5	1	6	10	–	–	1	4	2	–	7	17
		19	18	14	7	58	35	34	69	127	7	6	25	76	38	28	180	307

The last series of cases I am able to give relate to *children only*. Dowlais is an elevated part of Merthyr Tydfil, inhabited almost solely by colliers and iron workers; the others are manufacturing towns:

Name of Observer.	Place and Year.	Ages.								
		Months.				Years.				
		0–	3–	6–	9–	Under 1.	1–	2–	1 and under 5.	Under 5.
Dr. Taylor	Burslem, 1881	5	6	8	3	22	6	3	9	31
Do.	Do. 1882	6	5	2	1	14	7	2	9	23
Dr. Birt	Stourbridge, 1881	1	—	3	3	7	2	—	2	9
Do.	Do. 1882	3	3	—	1	7	3	1	4	11
Do.	Do. 1883	2	5	4	1	12	2	—	2	14
Do.	Do. 1884	—	3	3	6	12	7	—	7	19
Dr. Weleh	Birmingham Children's Hospital, 1881.	10	16	14	13	53	43	21	64	117
Do.	Do. 1882	2	4	3	3	12	10	1	11	23
Dr. Mason	Dowlais, 1883	—	2	7	9	18	21	—	21	39
Dr. Lloyd	Do. 1883	1	1	1	5	8	12	—	12	20
		30	45	45	45	165	113	28	141	306

Note here again the smaller number of cases under three months than at other tri-monthly ages under one year, and the equal number of cases at other ages under one, which of course means somewhat increasing actual incidence. Note also that the cases under one year are in excess of those between one and two years, and the small number of cases between one and five years; also the high proportion borne by those under one to all under five years.

At Children's Hospital, Great Ormond Street.

In Table X. (p. 69) are given the ages of children treated for diarrhœa in the out-patient department at the Children's Hospital, Great Ormond Street, during 12 years 1876 to 1887. The sex of the cases is also given, and in Table XI. (p. 70) I have calculated the incidence on the population at different ages under 15 years in the Registration Districts of London from which children are by any chance likely to have been brought for treatment there.

Generally it confirms the inference drawn from the other tables of age that I have given. But it is very obvious that the numbers at ages under one year at Great Ormond Street represent an incidence very much below the truth; this is probably due to the natural objection of mothers to bring out very young infants to the hospital from

any parts but those in the immediate neighbourhood, and perhaps partly to a reluctance to trouble subscribers for recommendations for such young infants, and to other very conceivable causes. The numbers over 10 years also are probably below the truth, as the exact limit of age of applicants over 10 years is not stated on the tables in the reports of the hospital. But the Tables show the high incidence on ages between one and two years as compared with that on older children, and indicate the lessening of incidence which goes on during the third year of child life. As respects the 878 infants under one year of age, Table X. (p. 69) tells the same tale as the Islington records with regard to the incidence of the malady on the tri-monthly periods of life, showing how small it is on infants under three months of age, and how it doubles in ages over three months, being little different (as would probably appear if the population at these small ages could be ascertained) at ages between 3 and 12 months.

Causation of "Diarahœa," by Dr. Ballard.

These tables further enable us to see the relative incidence of the malady upon children of the two sexes, and shows that the *male sex is distinctly more liable to it than the female, and this at all ages from birth upwards.*

Incidence on sexes.

The age and sex of the 340 *fatal* cases observed in Leicester were as follows :—

	Total.	Under 1 Month.		1 and under 2 Months.		2 and under 3 Months.		Under 3 Months.		3 and under 6 Months.		6 and under 9 Months.		9 and under 12 Months.		12 Months and upwards.	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Males - -	183	19	10·4	16	18·7	25	13·7	60	32·7	53	28·9	43	23·4	11	6·5	16	8·7
Females -	157	13	8·3	15	9·6	21	13·4	49	31·2	43	27·3	28	17·8	22	14·0	15	9·5
Both Sexes -	340	32	9·4	31	9·1	46	13·5	109	32·0	96	28·2	71	20·8	33	9·7	31	9·1

(c.) *Variations Year by Year in Diarrhœa Prevalence.*

Year by year variations.

The prevalence of diarrhœa among persons of all ages varies from year to year, but it is present in a greater or less degree in all years.

That the prevalence of the malady generally in the community varies year by year is a matter of notoriety. But my Islington records enable me to be more precise than this, and to show to what extent and in what way it varies. The extent and, in a degree, the manner of the variation are shown on Table II. (pp. 48 and 49), which deals with the distribution of diarrhœa over 12 years, 1857 to 1869 (excluding for obvious reasons the cholera year of 1866), of 15,478 cases of "diarrhœa" coming newly under observation in the poor law practice of the parish, and in certain institutions for the medical relief of the sick poor.*

What I would insist on as shown by this table is, 1st, that "diarrhœa" is a *malady always present* in a lesser or greater degree; and, 2ndly, that *in the years of greatest prevalence the number of cases* (taking population into account) *was in Islington little more than twice that of the years of least prevalence.* Compare the number of cases in the cold and exceptionally wet year, 1860, with the numbers in 1857 and 1868.† And it was much the same with my other records, *e.g.*, Redditch.

Malady is of yearly occurrence.

(d.) *Variations Year by Year in the Actual Incidence of Diarrhœal Sickness on Persons at different Ages.*

Year to year variation in incidence on ages.

There is variation as to actual incidence on ages in different years. This appears in the subjoined table. The populations living in Islington in the several years can be estimated from the figures given in the Census Table for 1851 and 1861 in respect of ages under and over five years, but as the Census Table for 1851 does not give the numbers living at the several ages under five, I have been under the necessity in this case of using the numbers given for 1861.

Islington observations.

* For charts of the diarrhœal sickness in these years up to 1868, and including 1866, see my paper in 11th Report of Medical Officer of the Privy Council, and, up to 1869, Chart. V. at end of the Report.

† It is necessary for explanation to say something about the *italicised* year 1866. It was a year in which cholera appeared epidemically in London. The first case in Islington occurred in the week ended 28th July (30th week of year). When the epidemic was threatened, the vestry, which was the local sanitary authority, established, in addition to the ordinary provision for the sick poor, stations, each with a medical man attached, in several of the poorest parts of the parish, and house-to-house visitations were made. In this way, many very slight cases, for the relief of which medical aid would probably not have been sought under ordinary circumstances, came under treatment. I have little doubt that, in the neighbourhood of the stations, some of these cases were simply due to alarm, but I have no means of estimating the proportion of such cases. The last case of cholera occurred in the week ended 24th November (47th week of year). The special provision above-mentioned came into operation on 24th July and ceased on 19th October.

Causation of "Diarrhœa," by Dr. Ballard.

—	Population 1861.		Estimated Population.		Cases of Diarrhœa.									
					Under 1 Year.		1 and under 5 Years.		Under 5 Years.		5 Years and upwards.		All Ages.	
	Under 1 Year.	1 and under 5 Years.	Under 5 Years.	5 Years upwards.	Number.	Per 1000. Population 1861.	Number.	Per 1000. Population 1861.	Number.	Per 1000. Estimated Population.	Number.	Per 1000. Estimated Population.	Number.	Per 1000. Estimated Population.
1857 - -	—	—	17,377	113,960	99	20·7	250	15·6	349	20·1	603	5·3	958	7·3
1858 - -	—	—	18,241	119,097	120	25·1	178	11·1	298	16·3	305	2·6	603	4·4
1859 - -	—	—	19,105	124,234	147	30·7	314	19·6	461	24·1	529	4·3	990	6·9
1860 - -	—	—	19,969	129,371	66	13·8	145	9·0	211	10·6	234	1·8	445	3·0
1861 (Census) -	4,788	16,045	20,833	134,508	130	27·2	333	20·8	463	22·2	442	3·3	905	5·8
1862 - -	—	—	21,619	139,565	120	25·1	231	14·4	351	16·2	264	1·9	615	3·8
Means .	—	—	19,524	126,789	113	23·7	242	15·0	355	18·2	397	3·1	753	5·2

The variation here is obvious. The actual incidence varied—

In the case of those

under 1 year from 30·7 to 13·8 = between 100 and 45 = difference 55.
over 1 year and under 5, „ 20·8 „ 9·0 = „ „ 43 = „ 57.
over 5 years „ 5·3 „ 1·8 = „ „ 34 = „ 66.

The greatest actual variation in the extreme instances was met with in those over five years, the variation at the other ages being about the same and much less than the difference over five years.

Redditch observations.

Comparing the Redditch series (*see* p. 25), with the Islington series, we find that the actual incidences varied—

In the case of those

under 1 year from 136·9 to 48·9 = between 100 and 36 = difference 64.
over 1 year and under 5, „ 66·7 „ 40·1 = „ „ 60 = „ 40.
over 5 years, „ 20·7 „ 6·8 = „ „ 33 = „ 67.

The greatest actual variation in extreme instances, then, was met with (as in Islington) in those over five years, although it was not much less in those under one year; the least variation in the extreme instances being in those between one and five years.

Year by year variation most obvious on those over five years old.

In years of greater general prevalence the increased prevalence is more obvious on the whole upon those over five years of age than upon those under five years: as respects those under five years, the increased prevalence in such years may be most obvious on the whole, either upon those under one year or upon those between one year and five years, this being, apparently, dependent on locality or character of population.

Islington observations.

Thus, as respects years of high or low general prevalence respectively, we find in Islington the actual incidence on ages to have been as follows:—

Years.		Births.	Actual Incidence of Diarrhœa.					
			Cases.	Rate per 1,000 of Births.	Per 1,000 Population, 1861.		Per 1,000 Estimated Population.	
				Under 1 year.	Under 1 Year.	1 Year and under 5.	Under 5 Years.	5 years and upwards.
Of Greater Prevalence	1857 -	4,591	99	21·6	20·7	15·6	20·1	5·3
	1859 -	4,997	147	29·4	30·7	19·6	24·1	4·3
	1861 -	5,526	130	23·5	27·2	20·8	22·2	3·3
	Total Means -	Total 15,114	Total 376	24·9	26·1	18·6	22·2	4·2
Of Less Prevalence	1858 -	4,413	120	27·2	25·1	11·1	16·3	2·6
	1862 -	5,580	120	21·5	25·1	14·4	16·2	1·9
	1860 -	5,184	66	12·7	13·8	9·0	10·6	1·8
	Total Means -	Total 15,177	Total 306	20·2	21·3	11·5	14·4	2·1

That is to say, the difference between the actual incidence on ages in the *aggregate* of years of greater or less prevalence was— Causation of "Diarrhœa," by Dr. Ballard.

In those under 1 year,	as 100 to 82	= difference	18.
„ 1 year and under 5,	„ 62	= „	38.
„ under 5 years,	„ 64	= „	36.
„ over 5 years,	„ 50	= „	50.

Looking, then, at the actual incidence on age, it is obvious that, on the whole, in Islington greater or less general prevalence affected most those over five years, next those between one and five years, and least of all those under one year.

In confirmation of this estimate of incidence of those under one year I have in the above table added columns to show that when these diarrhœa deaths are calculated upon the births similar results are obtained.

Comparing the Redditch series with the Islington series we find, as respects the years of greater or less general prevalence, the actual incidence of age to be as follows:— Redditch observations.

Years.		Per 1,000 Estimated Population.			
		Under 1 Year.	1 Year and under 5.	Under 5 Years.	5 Years and upwards.
Of Greater Prevalence	1884 -	116·3	55·7	69·4	20·7
	1883 -	136·9	66·7	82·5	14·1
	1887 -	94·3	40·1	52·3	17·5
	Means -	115·2	48·2	67·6	17·5
Of Less Prevalence	1885 -	99·1	46·1	58·1	13·7
	1886 -	60·8	49·1	51·7	14·7
	1882 -	48·9	46·2	46·8	6·8
	Means -	70·1	47·0	52·3	11·9

That is to say, the difference between the actual incidence on ages in the *aggregate* of years of greater or less general prevalence was—

In those under 1 year,	as 100 to 61	= difference	39.
„ 1 year and under 5,	„ 98	= „	2.
„ under 5 years,	„ 77	= „	23.
„ over 5 years,	„ 68	= „	32.

We see, therefore, that in Redditch the difference of actual incidence in years of greater or less prevalence was observed most in the infants under one year, and nearly to the same extent in those over five years, and least of all in those between one and five years.

But both in Islington and in Redditch, in the aggregate, the difference in actual incidence in high or low years of general prevalence respectively was much greater in the case of those over five years of age than in the case of those under five years.

(*e.*) *Seasonal Variation within the same Year in the Amount of Diarrhœal Sickness.* Seasonal variation.

The malady is not only present among the population every year, but in all seasons and at all times of every year; but not in all seasons and times alike.

Cases of so-called "diarrhœa"* are never absent from medical practice throughout the year. It is further notorious that they vary in number at different periods of the same year. *Taking all ages together and all years together, there is found to be a gradual increase of prevalence from about the beginning of the year to somewhere beyond the middle of the year, and then a gradual diminution of prevalence up to the end of the year.* Annual progressive increase and decline.

Table II. (pp. 48 and 49) shows these facts and precisely what the character of the variation was in Islington. In Table II., I omit the figures of the extraordinary (cholera) year 1866 from calculation, and add, in place of them, those of the ordinary year 1869.

* *See* foot note on page 10.

Causation of "Diarrhœa," by Dr. Ballard.

1. The exact week of minimum and maximum prevalence is not the same necessarily in every year; the maximum and minimum prevalence are earlier or later in one year than another, but on the whole the above sequence of events is observed in each year. It does not however follow that, because a certain order and time of increase and decrease was observed in Islington, the same order as to time is to be met with in all other parts of the country.

As to "diarrhœal periods."

Islington observations.

2. We may divide the year into 13 periods of four weeks each, taking the first five of these periods as a "pre-epidemic" period (*i.e.*, from first to twentieth week of the year), the next five as an "epidemic" period (*i.e.*, from twenty-first to fortieth week), and the last three as a "post-epidemic" period (*i.e.*, from forty-first to fifty-second week. This having been done for Islington, we get from Table II. (pp. 48 and 49) the following figures:—

Periods of 4 weeks.	No. of Cases.			
1st	377			
2nd	415			
3rd	433	Pre-epidemic period = 2,320	or per 4-weekly period	464 = 14
4th	519			
5th	576			
6th	821			
7th	2,111			
8th	3,894	Epidemic period = 11,338	„ „	2,268 = 70
9th	2,972			
10th	1,540			
11th	869			
12th	540	Post-epidemic period = 1,820	„ „	607 = 18
13th	411			
				100

This was for a district in London; it does not follow that it would be precisely the same (and it might be and probably is very different,) for some other places; but I have reason for believing that it is, on the whole, similar over most of England and Wales. There is observable in this prevalence a time of comparative but not absolute quiescence during the first three of the above four-weekly periods, then a time during the next three periods of obvious advance, then a sudden greatly enhanced activity of advance to the maximum prevalence, and then a slower decline becoming more rapid during the last three four-weekly periods.

The following table shows the four-week periods which in each year in Islington exhibited the least and the highest prevalence of "diarrhœa." Chart V. (at end of report) shows the same facts graphically.

Year.	Min.*	Max.
1857	13th and 2nd	8th
1858	1st	9th
1859	1st	8th
1860	1st	9th
1861	13th and 1st	9th
1862	2nd	9th and 10th
1863	13th and 5th	8th
1864	13th and 1st	8th
1865	2nd	7th
1866	3rd	9th
1867	1st	8th and 9th
1868	12th and 2nd	8th
1869	2nd	8th

* When the actually smallest number of cases occurred at the latter end of the year I have added the 4-weekly period or periods when the next smallest numbers occurred in the earlier part of the year.

Tables VI. and VII. (pp. 58–66) enable us to compare with Islington the diarrhœal occurrences in Redditch during the seven years 1881–87.

The distribution of the Redditch cases for six complete years in the aggregate gives the following figures:— Causation of "Diarrhœa," by Dr. Ballard.

Periods of Four Weeks.	Number of Cases.			
1st	60			
2nd	49			
3rd	63	Pre-epidemic period	= 276, or per week, 13·8	= 18·3
4th	37			
5th	67			
6th	74			
7th	115			
8th	210	Epidemic period	= 921 ,, 46·0	= 61·0
9th	343			
10th	179			
11th	81			
12th	55	Post-epidemic period	= 185 ,, 15·4	= 20·7
13th	49			
				100

The number of cases during the first three of the four-weekly periods does not fairly represent average prevalence, since they were greatly augmented by an exceptional burst of diarrhœa among adults from some unascertained cause in the early weeks of 1886, as will be seen by reference to Table VII. (pp. 65 and 66). But making allowance for this, we observe on the whole, as in Islington, the periods of comparative quiescence, of active advance, and of subsequent decline.

But it will be observed that, while on the whole in Redditch the advance to epidemic prevalence begins at about the same period as that of the Islington series, the *maximum of cases is not attained until a month later*, the ninth four-weekly period instead of the eighth as in Islington; that is to say, the *rise to the maximum was on the whole more gradual and deliberate* than in Islington, *while on the other hand the decline was more rapid, especially at its commencement.* Redditch observations.

The following table shows the four-weekly periods in which the maximum and minimum prevalence was observed each year in Redditch:—

Year.	Minimum.	Maximum.
1881	?	8th
1882	4th	9th
1883	4th	11th
1884	2nd	9th
1885	1st and 2nd	8th
1886	13th	10th
1887	2nd	9th

3. Or we may look at the matter in another way (which may be more convenient for comparison with data elsewhere) and distribute the Islington cases among the four quarters of the calendar year. As to quarters of the year. Islington observations.

The malady was least prevalent in the first quarter of the year, most so in the third quarter, and more prevalent in the second quarter than in the fourth.

Of the 15,478 Islington cases there occurred in the—

1st quarter 1,350, or 8·7 per cent. of all the cases.
2nd ,, 2,606 ,, 16·8 ,, ,,
3rd ,, 9,376 ,, 60·7 ,, ,,
4th ,, 2,146 ,, 13·8 ,, ,,

What I wish to note here is, not only that there were *more cases during the second quarter than during the fourth, but* also that the *number of cases in the third quarter* (the quarter usually of highest prevalence) was, after all, *only about three and a half times that of the second quarter*, while the cases of the fourth were about four and a third times less than the third.

The tables in the annual reports of the Manchester Children's Hospital enable me to compare with the above tables the average prevalence of diarrhœa in different parts of the year among children under about 14 years of age in that city. Table IX. (p. 68) is Manchester observations.

Causation of "Diarrhœa," by Dr. Ballard.

constructed from these tables. The particulars are given in calendar months of admission to the out-patient department. In calendar months and quarters of the year they ran in the aggregate of 10 years 1878 to 1887 thus :—

Of 9,346 Manchester cases there occurred in—

January	407	
February	473	1st quarter 1,363, or 14·6 per cent. of all cases.
March	483	
April	431	
May	459	2nd quarter 1,465, or 15·7 „ „
June	575	
July	1,196	
August	1,911	3rd quarter 4,718, or 50·5 „ „
September	1,611	
October	905	
November	549	4th quarter 1,800, or 19·3 „ „
December	346	

We see here these differences from the all-age Islington tables given above. 1. That, as compared with Islington, the cases were relatively to the total of the year more numerous in the 1st and 4th quarters at the expense seemingly of the 3rd quarter. 2. That there was little difference between the 1st and 2nd quarters. 3. That the disease was on the whole least prevalent not in the first few weeks of the year but in the last few weeks. A check of the increased prevalence in those children's cases (alluded to on p. 42) is seen here in April and May. We also see the explosive rise in July and the much more gradual decline through September and October.

Manchester observations in "diarrhœal periods."

The nearest approach that can be made to a division of these Manchester data into diarrhœal periods will be by counting into a "Pre-epidemic" period the cases in the months of January, February, March, April, and half the cases in May; into the "Epidemic" period the remaining cases in May, the cases in June, July, August, September, and a fourth of the cases in October; and into a "Post-epidemic" period the remaining cases in October and the cases in November and December. Proceeding thus we get the following figures :—

Pre-epidemic period	2,024 cases, or per 4-weekly period	-	405=20
Epidemic „	5,748 „ „	-	1,150=55
Post-epidemic „	1,574 „ „	-	525=25
			100

Comparing these with the *cases under* 15 *years of age in Islington* in the aggregate of six years (as gathered from Table IV., p. 51), we get the following figures :—

Pre-epidemic period	319 cases, or per 4-weekly period	-	64=10
Epidemic „	1,949 „ „	-	390=70
Post-epidemic „	348 „ „	-	116=20
Whole six years	2,616		100

Difference from Islington observations.

So it would appear that in the case of children at all events the distribution of the year's cases on the whole is not quite the same in Manchester as it was in Islington. There is much less inequality among the seasons than was observed in Islington, and either the summer epidemics are much less remarkable for extent among children, or the influences which produce the epidemic, spread their operation onwards much more decidedly into the post-epidemic period and the following pre-epidemic period. The much nearer correspondence than was observed in Islington between the numbers in the post-epidemic and pre-epidemic periods renders the last suggestion a probable one.

The distribution of cases through the different parts of the year is thus not precisely the same in all places.

As in Islington, again, the exact time in the year of maximum and minimum prevalence in Manchester is not the same every year, as is seen by the following table :— Causation of "Diarrhœa," by Dr. Ballard.

Years.	Months of	
	Minimum Prevalence.	Maximum Prevalence.
1878	December	August
1879	January	September
1880	April, January, and November	August
1881	January	July
1882	December and February	August
1883	December	August
1884	December	September and August
1885	February	August
1886	December	September
1887	May	August

So far as one can judge from this table as compared with that for Islington (where the year is not divided exactly in the same way) the minimum prevalence was usually arrived at sooner among the children in Manchester than it was among the all-age cases in Islington, and the maximum was arrived at a little later.

The prevalence of the malady about the middle period of the year is sufficiently great to constitute it then an "epidemic;" and we accordingly hear it spoken of at that season as "epidemic diarrhœa." Diarrhœa "epidemic" in middle of year.

The year having been divided into Epidemic, Post-epidemic, and Pre-epidemic periods, the actual and the average weekly prevalence in Islington in each of the periods thus constituted are shown in Table III. (p. 50). What the table on p. 32 tells us is this, that *in the "epidemic" period the four-weekly prevalence was about five times that of the "pre-epidemic" period, while the four-weekly prevalence during the "post-epidemic" period was only about one-fourth that of the "epidemic" period.*

The difference between these three periods is less marked in the Redditch series (*see* p. 33) ; the relative four-weekly numbers of the "epidemic" and "post-epidemic" periods are nearly the same as in the Islington series (the "post-epidemic" period being about one-third that of the "epidemic"), but the four-weekly numbers in the "pre-epidemic" period are too large in consequence of the disturbance noted above.

Very much the same kind of distribution of cases is found, as shown by Table IV. (p. 51), of the 4,516 cases which occurred solely in the poor law practice of Islington during 1857–62.

It will be found convenient* for some purposes of this report to constitute a "*diarrhœal year*" of these three periods taken thus : 1. Epidemic period ; 2. Post-epidemic period ; 3. Pre-epidemic period ; regarding the "diarrhœal" year as commencing with the twenty-first week of the calendar year, and terminating with the twentieth week of the next year. Constitution of a "diarrhœal year."

(*f.*) *Variations Year by Year in the seasonal Distribution of Diarrhœal Sickness.*

Year to year variation on seasonal distribution of diarrhœa.

Whether we regard a year as "calendar" or "diarrhœal," no meteorological circumstances† that are likely to occur in this country are capable of preventing the appearance of epidemic prevalence of the malady to some extent in its customary epidemic season.

All that I have said above as to the general result of the distribution of cases of so-called "diarrhœa" through the year, does not apply strictly to every year alike. Diarrhœa never fails to become epidemic in customary season.

* But I must give the warning that this is *solely* an arrangement for *convenience*, for, as the Islington Table II. shows us that the actual (apparent) commencement, middle, and end of a diarrhœal year is not always the same every calendar year (and thus that an actual diarrhœal year may sometimes be shorter and sometimes longer), so there may be, and I believe are, places in the Kingdom where the actual diarrhœal year (its commencement, middle, and end) is very different from that which I have adopted for use in this report.

† For the more important of these circumstances, *see* p. 2.

Causation of "Diarrhœa," by Dr. Ballard.

This may be seen on an examination of the Islington figures for each year separately as given in Table II. (pp. 48 and 49). It will suffice here merely to call attention to the *quarterly* numbers of cases for the several years 1857–69 in Table II. of this report; they show how far from universal the average distribution into quarterly periods is when each year is looked at by itself; and for exhibiting any law governing the distribution, the arrangement of the figures into periods of a "diarrhœal year" appears preferable.

This has been done for Islington in Table III. (p. 50), and the distribution of the cases into "epidemic," "post-epidemic," and "pre-epidemic" periods shown, the number of cases at each period both relatively one to another and relatively to the population. The following are points observable in these tables:—

Variation of prevalence: 1. In "epidemic" period.

1. *Epidemic Period.*—There was *no year* in the series in which the "*epidemic*" period did not show cases in excess of either of the other periods, and indeed only one year in which its cases did not exceed those of the two other periods put together.* The year in which the least excess of the epidemic period over either of the other two periods was observed in Islington was 1860. We shall see hereafter that 1860 was a year most exceptionally unfavourable to the epidemic prevalence of diarrhœa on account of its remarkable meteorological circumstances. It could scarcely in this country have been more unfavourable, so that we may fairly infer that in this country no meteorological circumstances that are likely to occur in the course of any particular year are capable of preventing the appearance of some extent of epidemic prevalence in the customary season for it.

It is observable that, of year by year variations in prevalence, by far the greatest occurred in the "epidemic" period.

Islington.

The variations of diarrhœa in the pre- and post-epidemic periods are comparatively small. In the Islington series, putting aside the exceptional year 1866 (*see* p. 29), the greatest prevalence in the "epidemic" period (which occurred in 1857) exceeded the least prevalence (which occurred in 1860) in the proportion of 31 to 10 (81 to 26 per 10,000 of population), *i.e.*, the prevalence of 1857 was a little more than three times that of 1860. *Prevalence, in the epidemic period, in excess of the average occurred in five years out of eleven.*

Redditch.

In the Redditch series, as shown in Tables VII. and VIII. (pp. 65–67), the greatest prevalence in the "epidemic" period (which occurred in 1884), exceeded the least prevalence (which occurred in 1882) in the proportion of 3 to 1 (20·4 to 6·9 per 1,000 of population). And as in the instance of Islington, there was no year of the series in which the prevalence during the epidemic period did not exceed that in either of the other two periods, nor any year, except the comparatively low diarrhœal year 1886, in which it did not exceed the prevalence in the other two taken together. *Prevalence, in the epidemic period, in excess of the average, occurred in four years out of seven.*

2. In "post-epidemic" period.

2. *Post-epidemic Period.*—Comparatively small as are the year by year diarrhœal variations of the "post-epidemic" and "pre-epidemic" periods, they are worthy of consideration as bearing upon etiology.

Islington.

The extremes of prevalence in the "*post-epidemic*" period in the Islington series were 14 in 1862 and 7 in 1859, that is to say, the highest prevalence was twice that of the lowest.

It is to be remarked that "*post-epidemic*" *prevalence* (*per* 10,000 *population*) *in excess of the average of that period* occurred in the Islington series in only *four years out of eleven.* It is further to be remarked that of these four years (1860–61, 1861–62, 1862–63, and 1865–66), only one (1861–62) was a year in which the annual prevalence exceeded the average of the eleven. *Post-epidemic prevalence in defect of the average occurred in five years out of eleven, and of those, three* (viz., 1858–59, 1864–65, and 1867–68) *were years of annual prevalence below the average,* and *also years in which the prevalence during the "epidemic period" had been below the average prevalence.*

But taking all the eleven years, I believe I see an indication that a higher prevalence than usual in the "post-epidemic" period may be connected with a deficiency of customary prevalence in the preceding "epidemic period."

---

* In the year 1860 the number of cases in the post-epidemic period should be raised two-thirds, *i.e.*, from 156 to 260, and 260 + 194 = 454, a considerable excess upon 395.

By arranging the years thus:—

	Diarrhœal Years (Islington).	Actual Prevalence per 10,000 Population.		
		Whole Diarrhœal Year.	Epidemic Period.	Post-epidemic Period.
Excess of All Age prevalence in Epidemic period	1868–69	102	80	7
	1857–58	101	81	9
	1859–60	95	75	7
	1861–62	89	67	10
	1863–64	82	62	8
	Means	93·8	73·1	8·3
Deficiency of All Age prevalence in Epidemic period	1865–66	76	54	11
	1867–68	72	50	8
	1864–65	67	51	7
	1858–59	64	45	8
	1862–63	59	34	14
	1860–61	50	26	10
	Means	65·4	43·3	9·6

we find the extremes of deficiency in the "post-epidemic" periods in the first series, and those of excess in the second series.

But it would appear that it is only *great* excess or deficiency in the "epidemic" period which is able to overcome very obviously the influence of other circumstances operating actually in the "post-epidemic" period, or preceding it.‡

One of the "other" preceding circumstances just mentioned as influencing prevalence during the "post-epidemic" period appears to be the lateness or earliness of the attainment of the maximum prevalence in the preceding "epidemic" period.

When the epidemic maximum is attained late the prevalence of the disease in the "post-epidemic" period tends to be greater than when the epidemic maximum is attained early. The "epidemic" season seems then to run more or less into the (*adopted*) *"post-epidemic" period.*

The following table gives evidence of this:—

	"Diarrhœal" Years.	4-weekly Period of Maximum Epidemic Prevalence.	Actual Week of Maximum Epidemic Prevalence.	Post-epidemic Prevalence per 10,000 Population.	Next succeeding Pre-epidemic Prevalence per 10,000 Population.
Years of late maximum prevalence	1860–61	9th	35th	10	13
	1861–62	9th	34th	10	12
	1862–63	9th and 10th	33rd	13	11
	1858–59	9th	33rd	8†	11
	1866–67*	9th	33rd	18	10
Years of early maximum prevalence	1857–58	8th	34th	9	11
	1868–69	8th	31st	7	15
	1863–64	8th	30th	9	12
	1864–65	8th	30th	7	9
	1869–70	8th	30th	10	?
	1867–68	8th and 9th	29th and 36th	8	14
	1859–60	8th	29th and 30th	7	12
Years of very early maximum prevalence	1865	7th	28th	11†	11

* Cholera year.

† In 1858 the temperature was more or less considerably below the average in seven out of the 12 weeks of the "post-epidemic" period; and in 1865 it was unusually warm in the latter part of the epidemic period (indeed the temperature was at its maximum for the year in the 36th and 37th weeks), and at the commencement and middle of the post-epidemic period.

‡ I may anticipate so far as to say that temperature has an influence upon the diarrhœa in the "post-epidemic" period, as well as in the "epidemic" period, and that its tendency in the "post-epidemic" periods of years 1857, 1861, 1863, and 1868 (of the first series) was to raise the diarrhœa above the average, and in the year 1859 to depress it below the average. In the one case it antagonised and in the other assisted the influence under consideration.

Similarly its tendency in the "post-epidemic" period of 1865 (of the second series) was decidedly to raise the diarrhœa above the average, and in 1867, 1864, 1862, and 1860 to lower it. In the former case it assisted in the latter cases it antagonised the influence under consideration.

These points are in favour of the view that the influence of excess or deficiency in the "epidemic" period is really more operative than it at first sight appears to be.

Causation of "Diarrhœa," by Dr. Ballard.

In Redditch (Table VIII., p. 67) the extremes of actual incidence in the "post-epidemic" period correspond with Islington. They were 4·6 and 2·0, that is to say, the highest prevalence was about $2\frac{1}{4}$ times the lowest.

Redditch.

Examined as to relation of post-epidemic prevalence to antecedent epidemic prevalence, the Redditch series gives figures as follows :—

	Diarrhœal Years. (Redditch.)	Cases in Epidemic Period per 1,000 Population.	Cases in Post-epidemic Period per 1,000 Population.
Excess of All Age prevalence in Epidemic period.	1884	20·4	2·8
	1887	17·6	2·0
	1883	14·6	4·6
	1885	14·4	2·3
		16·8	2·9
Deficiency of All Age prevalence in Epidemic period.	1886	10·1	3·2
	1881	9·2	2·3
	1882	6·9	2·2
		8·8	2·6

And the result therefore is the reverse of that observed as to Islington. All places then do not follow the indication of the Islington figures, to the effect that a higher prevalence in the "post-epidemic" period is connected with a deficiency of the customary prevalence in the preceding "epidemic" period. But it must be kept in mind that in Redditch the height of the epidemic season is delayed to a later period than in Islington, and the "epidemic" period therefore has to be regarded as habitually encroaching somewhat upon the "post-epidemic" period. The importance of this consideration is evidenced by the following table :—

	Diarrhœal Years. (Redditch.)	Four-weekly Period of Maximum Prevalence in Epidemic Period.	Actual Week of Maximum Epidemic Prevalence.	Cases in Post-epidemic Period per 1,000 Population.
Years of late Maximum prevalence.	1883	11th	40th	4·6
	1886	10th	36th	3·2
Years of Medium Maximum prevalence.	1884	9th	35th	2·8
	1887	9th	35th	2·0
	1882	9th	34th	2·2
Years of Early Maximum prevalence.	1881	8th	32nd	2·3
	1885	8th	31st	2·3

Thus judged of, the experience of Redditch is altogether in accord with that of Islington. *So that it would appear that the lateness or earliness of attainment of maximum prevalence in the epidemic period has more to do with the post-epidemic prevalence than the degree of prevalence in the epidemic period has to do with it.*

3. In "pre-epidemic" period.

3. *Pre-epidemic Period.*—In Islington the extremes of prevalence in the "*pre-epidemic*" period were 9 and 15 per 10,000 population, that is to say, the difference in prevalence in different years was less than was observable in the "post-epidemic" periods and vastly less than in the "epidemic" periods. The highest prevalence was not more than two-thirds higher than the lowest.

There are indications (although faint) of a tendency in the diarrhœa of the "pre-epidemic" period to be more prevalent according as that in the "post-epidemic" period preceding had been less prevalent, and vice versâ.

That this is so in Islington and that the prevalence there in this (the pre-epidemic) period was more closely related to the prevalence that preceded it than to that which was about to follow it* is seen by the following arrangement of the dates.

Diarrhœal Year.	Whole Diarrhœal Year.	Actual Prevalence per 10,000 Population.					
		In Epidemic Period.	In Post-Epidemic Period.	Total in Epidemic and Post-Epidemic Periods.	Pre-epidemic Period of next Calendar Year.	Following Epidemic Period.	Following Diarrhœal Year.
1860–61 - -	50	26	10	36	13	67	89
1862–63 - -	59	34	14	48	11	62	82
1858–59 - -	64	45	8	53	11	75	95
1864–65 - -	67	51	7	58	9	54	76
1867–68 - -	72	50	8	58	14	80	102
1865–66 - -	76	54	11	65	11	[108	136]
Means -	65·4	43·3	9·6	52·9	11·5	—	—
1863–64 - -	82	62	8	70	12	51	67
1861–62 - -	89	67	10	77	12	34	59
1859–60 - -	95	75	7	82	12	26	50
1857–58 - -	101	81	9	90	11	45	64
1868–69 - -	102	80	7	87	15	53	?
Means -	93·8	73·1	8·3	81·4	12·4	41·8	—

Nevertheless there is an indication that, as a rule, *the greater the prevalence during the previous parts of the diarrhœal year "epidemic" and "post-epidemic" taken together, the greater* (subject of course to the modifying influence of other circumstances) *will be the prevalence in a succeeding pre-epidemic period*, and *vice versâ*.

The table on p. 37 gives no indication that lateness of maximum prevalence in any year affects the prevalence in the "pre-epidemic" period of the next calendar year in the way that it affects prevalence in the "post-epidemic" of its own calendar year. The reverse would rather appear to be the case, since *the highest "pre-epidemic" prevalence occurred on the whole when the prevalence of the preceding calendar year had been comparatively early.*

And, as respects *any relation between one diarrhœal year and that next succeeding*, there is a further suggestion in the above table (on this page), on comparing the two series of years. That in the second series the influences operating to produce the diarrhœa in each diarrhœal year might have exhausted themselves before the commencement of the new diarrhœal year, but that in the first series they might not have altogether exhausted themselves.†

Indeed it looks altogether very much as if *in the course of what I term the "pre-epidemic" period* there *may be an overlapping, so to speak, of two "diarrhœal" years*, some of the cases being a residue from the old, and some of the cases belonging rather to the new epidemic season.

A consideration of the weekly figures in Table II. (pp. 48 and 49) will strengthen some of these inferences. Each year is marked by its own peculiarities of distribution of cases in each diarrhœal period.

The numbers in the "pre-epidemic" periods of the Redditch series are too much disturbed by the unusual occurrences in 1886‡ to allow of any fair comparison with the Islington series in respect of these points.

It will be observed (*see* tables on pp. 37 and 39) that none of the severer epidemics began late, some, such as that of 1868–69, began very early, but a comparatively late commencement is no guarantee that the epidemic will not be severe, *e.g.*, 1857–58. The only very late commencement in the series, however, was in 1860–61, and the epidemic was a trifling one.

* This justifies my arrangement for the construction of a "diarrhœal year."

† It is to be observed that the epidemic period of 1861–2 was by no means a very hot one, only 11 out of the 20 weeks having had a temperature above the average and then not very much above it.

‡ *See* foot note to Table VIII., page 67 of the report.

Causation of "Diarrhœa," by Dr. Ballard.

(*g.*) *Seasonal Variations in the Incidence of Diarrhœal Sickness on Persons of different Ages.*

Seasonal variations in incidence on different ages.

The extent to which persons of different ages are affected by the malady in the different seasons of the year may be studied in Tables IV. and V. (pp. 51–57), which deal with this detail as wrought out upon the 4,516 cases in the poor law practice of Islington during the six years 1857–62.

The Tables show the *actual* incidence of the malady *upon the population at different ages in the different four-weekly periods* of the year.

As to ages under and over 5 years and over 55 years: Islington.

(1.) *It is noticeable for the aggregate of the six years* (*Table IV., p.* 51) *as regards ages under* 5 *and ages over* 5 *years that minimum and maximum incidence were both attained simultaneously by each, namely, in the first and eighth four-weekly period respectively of the calendar year; and that the rates of attack at these two age periods increased from minimum to maximum and declined again from maximum to minimum on exactly parallel lines.*

Table IV. (p. 51) serves further to show that *in the aggregate, the minimum and maximum incidence in the case of old people* (55 years of age and upwards) *falls upon the same four-weekly periods as in the case of younger people and children.*

The following table for Islington shows *for each year individually* how the *minimum* and *maximum* incidence fell upon the several important groups of ages :—

Years	Four-weekly Periods at which the Minimum and Maximum Prevalence were attained.					
	Minimum Prevalence.			Maximum Prevalence.		
	Ages in Years.			Ages in Years.		
	0—5	5 and upwards.	55 and upwards.	0—5	5 and upwards.	55 and upwards.
1857	?	?	?	8th and 9th	8th	8th
1858	3rd	2nd	1st, 12th, and 13th	9th and 7th	9th	7th
1859	12th, 3rd, and 4th	3rd	1st 3rd, and 5th	8th	8th	8th
1860	1st	4th	4th	9th	8th and 9th	8th
1861	1st	13th	12th, 13th, 2nd, 4th, and 5th.	9th and 8th	9th	9th
1862	2nd	1st and 2nd	4th, 7th, and 11th	8th and 9th	9th and 8th	9th

These observations *as regards the time of minimum incidence* are of little value by reason of the small number of cases on which they are founded. *As regards the time of maximum incidence*, the correspondence year by year between those under and over five years, and of those aged 55 years and upwards, is sufficiently close to be regarded as identical.

Redditch.

On the whole the same fact as regards those under and over five years of age is observable in the case of the seven years of the Redditch series (Table VII., pp. 65 and 66) in only one of which (1883) was the correspondence imperfect.

Leicester.

Moreover, in the Leicester series, the number of cases being stated in weeks, we can observe (Table VI., pp. 58-64) that the maximum of cases over and under five years occurred not only in the same four-weekly period but (with one exception) actually in the same week (not meaning the same week in every year).

The four-weekly periods, and the actual weeks of maximum incidence at Leicester, were :—

Years.	Four-weekly period.		Week of Year.	
	0—5 years.	5 years & upwards.	0—5 years.	5 years & upwards.
1881	8th	8th	30th	32nd
1882	9th	9th	32nd	32nd
1883	9th	9th	35th	35th
1884	9th	9th	34th	33rd and 34th
1885	8th	8th	30th	30th
1886	8th	8th	29th	29th
1887	7th	7th	28th	28th

This is an important point in the evidence that *we have to do with the same malady in infants and older persons alike.*

Causation of "Diarrhœa," by Dr. Ballard. — As to ages between 1 year and between 1 and 5 years: Islington.

Recurring to the Islington Summary Table IV. (p. 51), and *having regard to children under five years only*, we find that although the *minimum* number of cases under one year and between one and five years did not occur in the same four-weekly period (it nearly did so and might have been found to do so had larger numbers been available), the *maximum* number of cases at these several ages did occur in the same four-weekly period.

Looking to the six years individually, and dealing first with the *minima* of cases at ages 0–1 and 1–5 years.

In 1857	the *minimum* period under 1 year of age	is not ascertainable.			The *minimum* of ages 1–5 years	is also not ascertainable.		
1858	„	„	was in 1st and 3rd	4-weekly period.	„	„	was in 3rd	4-weekly period
1859	„	„	was in 11th and 12th	„	„	„	was in 1st and 3rd	„
1860	„	„	was in 1st and 2nd	„	„	„	was in 4th	„
1861	„	„	was in 4th, 5th, and 12th	„	„	„	was in 1st	„
1862	„	„	was in 2nd	„	„	„	was in 2nd	„

The numbers are all too small to gather a substantial inference from except perhaps this, that there is no necessary correspondence; but taking the six years, year by year, *it is seen* that while the *minimum of cases under one year of age may be met with in the "post-epidemic" period, the minimum of cases aged one year but under five years was in each instance met with in the "pre-epidemic" period.*

Dealing next with the *maxima* of cases at ages 0–1 and 1–5 years:—

In 1857	the *maximum* period under 1 year of age	was in 8th	4-weekly period.		The *maximum* of ages 1–5 years	was in 9th	4-weekly period.	
1858	„	„	was in 9th	„	„	„	was in 7th and 9th	„
1859	„	„	was in 8th	„	„	„	was in 8th	„
1860	„	„	was in 9th	„	„	„	was in 9th	„
1861	„	„	was in 8th	„	„	„	was in 9th	„
1862	„	„	was in 8th	„	„	„	was in 9th	„

The inference from this, so far as it goes, is that *there is observable a tendency for the maximum cases under one year of age to be reached sooner than the maximum between one and five years of age.*

Redditch.

In the Redditch series (Table VII., pp. 65–66) the *maximum* number of cases was met with thus:—

In 1881	the *maximum* 4-weekly period for those under 1 year	was in 8th	4-weekly period.		For those at ages 1–5 years	was in 8th	4-weekly period.	
1882	„	„	was in 7th	„	„	„	was in 9th	„
1883	„	„	was in 10th	„	„	„	was in 9th	„
1884	„	„	was in 9th	„	„	„	was in 9th	„
1885	„	„	was in 8th	„	„	„	was in 9th	„
1886	„	„	was in 7th	„	„	„	was in 10th	„
1887	„	„	was in 9th	„	„	„	was in 9th	„

This corresponds fairly with the Islington results.

Leicester.

The four-weekly periods, and the *actual weeks* of *maximum* incidence at Leicester, were:—

Years.	0–1	1–5	0–1	1–5
	4-weekly period.	4-weekly period.	Week of year.	Week of year.
1881	8th	8th	30th	30th
1882	9th	9th	32nd	32nd
1883	9th	9th	35th	34th and 35th
1884	9th	9th	34th	34th
1885	8th	8th	31st	30th
1886	8th	8th	29th	29th
1887	7th	7th	28th	28th

Throughout, the maxima occurred in the same four-weekly period, and for the most part actually in the same week.

Causation of "Diarrhœa," by Dr. Ballard.

As to ages 1 to 5 years and over 5 years: Islington.

As regards ages 1–5 and 5 years and upwards, and *comparing*, for Islington (Tables V., pp. 52–57) *the period of attainment of the maximum of cases in the instances of those between one and five years of age and those over five years of age*, we find:—

In 1857	the *maximum* period of ages 1–5 years	was in 9th	4-weekly period.		The *maximum* of ages over 5 years	was in 8th	4-weekly period.
1858	" "	was in 7th to 9th	"		" "	was in 9th	"
1859	" "	was in 8th	"		" "	was in 8th	"
1860	" "	was in 9th	"		" "	was in 8th and 9th	"
1861	" "	was in 9th	"		" "	was in 9th	"
1862	" "	was in 9th	"		" "	was in 9th	"

The inference being that *the period of the attainment of the maximum is nearly the same in those between one and five years and those over five years.*

Redditch.

The Redditch series runs as follows:—

In 1881	the *maximum* period for ages 1–5 years	was in 8th	4-weekly period.		For ages 5 and upwards	was in 8th	4-weekly period.
1882	" "	was in 9th	"		" "	was in 9th	"
1883	" "	was in 9th	"		" "	was in 11th	"
1884	" "	was in 9th	"		" "	was in 9th	"
1885	" "	was in 9th	"		" "	was in 8th	"
1886	" "	was in 10th	"		" "	was in 10th	"
1887	" "	was in 9th	"		" "	was in 9th	"

Leicester.

The Leicester series runs thus:—

Years.	1–5	5 and upwards.	1–5	5 and upwards.
	4-weekly period.	4-weekly period.	Week of year.	Week of year.
1881	8th	8th	30th	32nd
1882	9th	9th	32nd	32nd
1883	9th	9th	34th and 35th	35th
1884	9th	9th	34th	33rd and 34th
1885	8th	8th	30th	30th
1886	8th	8th	29th	29th
1887	7th	7th	28th	28th

A practical correspondence; but with an apparent tendency of those between one and five to attain their *maximum* a trifle *earlier* than those over five.

There appears, therefore, on the whole, from the above observations, to be the following tendency to sequence in attainment of the maximum of cases in any year, viz., 1°, *those under one year of age;* 2°, *those over one year of age.*

As to age-periods under 1 year.

Referring again to the Summary Table IV. (p. 51) and *having regard to infants under one year only* in their *tri-monthly periods of age*, I must first of all call attention to a remarkable observation from the table, viz., that *in the "pre-epidemic" period the gradual increase* of cases 0–1 year in the aggregate from four weeks to four weeks observable at other ages does not occur steadily, but *is checked at the fourth four-weekly period, when, for two months (viz., during the fourth and fifth four-weekly periods), an actual lessening of cases to or near the minimum took place* curiously enough just before what may be almost called an explosion of cases in the seventh *four*-weekly period. We see nothing like this at other ages.

There is also some sort of indication of this check in the Tables V. (pp. 52–57) of each year, but it is most obvious in the tables for 1859, 1861, and 1862.

The same tendency may be traced in the Redditch series, Table VII. (pp. 65 and 66). (See also Manchester observations, p. 34.)

On the whole in Islington *the least* incidence on those—

under 3 months was during the "post-epidemic" period.
between 3 months and 1 year during the "pre-epidemic" period.

The number of cases dealt with were too small to permit of a more accurate statement.

As respects the *maximum of cases* at ages 0–1 year, in the aggregate it *occurred for those at ages under three months, at three and under six months, and at nine and under* 12 *months in the same four-weekly period, viz.*, the eighth, which was the period of aggregate maximum for other ages generally, viz., those between one and five years and those over five years. Practically *the maximum for those between six and nine months was the same or a trifle later.*

Taking the years individually the *four-weekly periods* at which each tri-monthly age period gained its maximum may be stated thus :— Causation of "Diarrhœa," by Dr. Ballard.

Years.	Ages in Months.			
	0–	3–	6–	9–12.
1857	7th, 8th, & 9th	7th	9th	8th
1858	7th	7th & 8th	9th	8th
1859	8th	8th	8th	7th & 8th
1860	10th	9th	9th	9th & 10th
1861	8th	8th	8th	8th
1862	8th	8th	9th	10th

There is here an indication of a *tendency in the youngest infants to attain their maximum of cases a little earlier than older infants, and of those between six and nine months to attain their maximum a little later than infants at other ages.*

(2.) At all ages there is *a tendency to explosiveness in the way the malady bursts out* in the *epidemic* season. Table IV. (p. 51) shows this for Islington in the aggregate of years, and also that this tendency to explosiveness is *less marked in the instances of those over five years, among whom the increase in cases as the year goes on is more deliberate, and what sign of explosiveness there is among them occurs later than in those under five years.* Mode of epidemic outburst.

Referring now to Tables V. (pp. 52–57) for the indication of this in individual years, we find it applying to 1857, 1858, 1859, 1861, but only remarkably to those under one year in 1860, and to those under one and over five years in 1862.

The Leicester Tables (mainly on account of the late period at which in most years the observations were commenced) are not available for comparison with Islington in this matter.

The *decline of epidemic prevalence*, after the attainment of its maximum, may be rapid or gradual, but is *rarely so rapid as the rise to the maximum* at the beginning of the epidemic season. Mode of epidemic decline.

This for all ages together is apparent to the eye in Charts III., IV., and V. at end of this report. It would appear that *the earlier the maximum is attained the more gradual is the decline*, the malady lessening in a more lingering manner than when the maximum is attained later.

Both these statements *appear to apply to each of the age periods, under one year, one to five years, and five years and upwards.*

VIII.—Previous Health in its relation to Fatal Attacks of Leicester Children.

Previous health of Leicester fatal cases :

1. The previous health of children who died in the 1881 and 1882 epidemics in Leicester was ascertained in 332 out of the 340 cases. Of these, 141, or 42 · 5 per cent., were recorded healthy, and some of them had been remarkably so from their birth until the fatal illness commenced. The remaining 191, or 57 · 5 per cent., had been either weakly from birth, or, having been born healthy and remained so for a longer or shorter time, had been subsequently weakened by disease antecedently to their fatal diarrhœal attack. It may be gathered from this that *infantile diarrhœal mortality is in part dependent upon previous general health.* influences diarrhœal mortality generally :

2. The following Table shows the *ages*, in months, at the time of the commencement of their fatal illnesses, of the healthy and weakly children respectively :— in relation to age :

	Totals.	Under 1 Month.	1–	2–	Under 3 Months.	3–	4–	5–	3 and under 6 Months.	6–	7–	8–	6 and under 9 Months.	9–	10–	11–	9 and under 12 Months.	12 Months and upwards.
Healthy	141	13	11	17	41	11	17	14	42	13	10	5	28	7	5	4	16	14
Weakly	191	18	20	26	64	20	18	15	53	14	17	10	41	8	4	4	16	17
Totals -	332	31	31	43	105	31	35	29	95	27	27	15	69	15	9	8	32	31
Weakly children *per cent.* of all fatally attacked at each age.																		
	57·5	58·1	64·5	60·5	61·0	64·5	51·4	51·7	55·8	51·9	63·0	66·6	59·4	53·3	44·4	50·0	50·0	54·8

Causation of "Diarrhœa," by Dr. Ballard.

The previous state of health appears then to exert its influence at all ages, but most remarkably under 9 months of age: commencing first dentition appears to have little or no influence.

in relation to duration of fatal illness:

3. *The influence exerted upon the duration of the fatal illness by previous healthiness or weakliness* is shown for all ages by the following Table :—

Duration.	Healthy.	Weakly.	Total.	Weakly, per cent. of Total.
Under 48 hours - -	6	14	20	70·0
2 and under 4 days - -	20	35	55	63·6
4 and under 7 days - -	43	47	90	52·2
7 and under 14 days -	42	48	90	53·3
14 and under 21 days . -	12	17	29	58·6
21 days and upwards - -	18	30	48	62·5
	141	191	332	57·5

It would seem from this table that previous *weakliness has very much to do with the* speedy collapse of the *most rapidly fatal cases* and *with the cases which have a duration of* 48 *hours and under* 4 *days, as also with the fatal cases of the most prolonged duration, i.e.*, 3 weeks and upwards. But still it is to be observed that 26 out of 75 children who died under 4 days were *not* weakly.

in relation to stage of epidemic.

4. The following table shows the *proportion of weakly to healthy children fatally attacked at different periods of the epidemic seasons of* 1881 *and* 1882 *in Leicester* in respect of 325 children as to whom both facts were recorded in my notes. Below I have bracketed the periods into fortnights for comparison with Table XIII. for these years at p. 73.

Fortnightly Periods.	1881.					1882.				
	Week of Commencement of Illness ending	Total Cases.	Healthy.	Weakly.	Weakly per cent. of Total.	Week of Commencement of Illness ending	Total Cases.	Healthy.	Weakly.	Weakly per cent. of Total.
1	July 9 (27th week of year.)	8	4	4	50·0	July 1 (26th week of year.)	7	3	4	57·1
	July 16	20	13	7	35·0	July 8	25	5	20	80·0
					39·3					75·0
2	July 23	39	15	24	61·5	July 15	15	10	5	33·3
	July 30	25	12	13	52·0	July 22	26	12	14	53·8
					57·8					46·3
3	Aug. 6	33	14	19	57·6	July 29	15	5	10	66·6
	Aug. 13	15	7	8	53·3	Aug. 5	18	5	13	72·2
					56·2					69·7
4	Aug. 20	9	2	7	77·7	Aug. 12	18	10	8	44·4
	Aug. 27	3	2	1	33·3	Aug. 19	13	5	8	61·5
					66·7					51·6
5	Sept. 3	—	—	—	—	Aug. 26	13	5	8	61·5
	Sept. 10	4	1	3	75·0	Sept. 2	6	2	4	66·7
					75·0					63·2
6	—	—	—	—	—	Sept. 9	9	4	5	55·5
	—	—	—	—	—	Sept. 17	4	1	3	75·0
					—					61·5
Total -		156	70	86	55·1	Total -	169	67	102	60·4

Or distributing the cases, so far as it can be done, into longer periods, *i.e.*, of 4 weeks each, we get the following results :—

1881.					1882.				
4 Weeks ended	Total Cases.	Healthy.	Weakly.	Weakly per cent. of Total.	4 Weeks ended	Total Cases.	Healthy.	Weakly.	Weakly per cent. of Total.
July 30	92	44	48	52·2	July 21	73	30	43	58·9
August 27	60	25	35	58·3	August 19	64	25	39	60·9
September 10 (2 weeks).	4	1	3	75·0	September 17	32	12	20	62·5

Our experience of these two Leicester epidemics then by no means supports an opinion commonly held that a summer diarrhœal epidemic makes its first fatal swoop upon the weakliest children. Like a good many other *a priori* beliefs, it will not bear the test of experience. The evidence indeed tends the other way, namely, that weakly children require a longer exposure to the epidemic cause, whatever that may be, than hearty children.*

The Tables and Charts which follow are those referred to in the preceding pages. In eight Appendices, A. to H., I add various details of evidence.

December 1888. EDWARD BALLARD.

* Perhaps I may be permitted to anticipate, and to say that I expect to be able to show that *food* is one of the media by which the contagium of "diarrhœa" gets into the system, and to suggest, as an explanation of this unexpected result of the Leicester inquiry, that weakly children have usually poorer appetites than hearty children, and hence are less likely to imbibe the contagium through food in the same quantity within the same period of time. Another and very different explanation may be suggested, however, viz., that weakly children (including on my list of cases, as I must do, the rickety children) have, by their prolonged and sustained exposure to the miasmatic causes which largely contribute to the production of weakliness in the class of children which furnishes the largest number of fatal cases of diarrhœa in all towns, acquired some tolerance of the specific contagium of the nature of an "acclimatisation." (See on this point some remarks in Appendix G., p. 124.)

TABLE I.—Showing the Number of Cases of "Diarrhœa" at different Ages occurring in the Poor Law Medical Service in Islington during each of the Six Years, 1857 to 1862, with the proportional Incidences of the Malady upon the several Ages in each Year and in Years of greater or lesser Prevalence of the Disease.

	Months of Age under 1 Year.				Total under 1 Year.	Years of Age, 1 and under 5.				Total 1 and under 5 Years.	Years of Age, 5 and upwards.									Proportional Incidence on Age.						
	0—	3—	6—	9—		1—	2—	3—	4—		5—	10—	15—	25—	35—	45—	55—	65—	75 and upwards.	Total 5 Years and upwards.	Total All Ages.	Under 5, per Cent. of All Ages.	Under 1, per Cent. of all under 5 Years.	Under 1, per Cent. of All Ages.	1 and under 5 Years, per Cent. of All Ages.	5 Years & upwards, per Cent. of All Ages.
Total of 6 years - -	92	212	211	167	682	769	357	211	114	1,451	281	202	286	497	447	307	200	131	32	2,383	4,516	47·2	32·0	15·1	32·1	52·8
[per Cent. of all under 1 year	13·5	31·1	30·9	24·5]																						
Years.																										
Of Greater prevalence — 1857	11	34	36	18	99	126	67	39	18	250	60	69	91	125	116	63	53	24	8	609	958	36·4	28·3	10·3	26·1	63·6
[per Cent. of all under 1 year.	11·1	34·3	36·4	18·2]																						
Of Greater prevalence — 1859	11	54	43	39	147	171	74	37	32	314	69	41	57	116	90	66	49	36	5	529	990	46·6	31·8	14·8	31·8	53 4
[per Cent. of all under 1 year.	7·5	36·7	29·3	26·5]																						
Of Greater prevalence — 1861	20	42	38	30	130	193	68	48	24	333	52	25	55	94	77	72	34	29	4	442	905	51·2	28·1	14·4	36·8	48·8
[per Cent. of all under 1 year.	15·4	32·3	29·2	23·1]																						
[per Cent. of all under 1 year	42	130	117	87	376	490	209	124	74	897	181	135	203	335	283	201	136	89	17	1,580	2,853	44·6	29·5	13·2	31·4	55·4
	11·2	34·6	31·1	23·1]																						
Of Less prevalence — 1858	16	35	40	29	120	86	51	24	17	178	35	26	23	65	67	42	27	11	9	305	603	49·4	40·3	19·9	29·5	50·6
[per Cent. of all under 1 year.	13·3	29·2	33·3	24·2]																						
Of Less prevalence — 1862	20	28	40	32	120	126	60	32	13	231	36	22	30	56	50	33	17	19	1	264	615	57·1	34·2	19·5	37·6	42·9
[per Cent. of all under 1 year.	16·7	23·3	33·3	26·7]																						
Of Less prevalence — 1860	14	19	14	19	66	67	37	31	10	145	29	19	30	41	47	31	20	12	5	234	445	47·4	31·3	14·8	32·6	52·6
[per Cent. of all under 1 year.	21·2	28·8	21·2	28·8]																						
[per Cent. of all under 1 year	50	82	94	80	306	279	143	87	40	554	100	67	83	162	164	106	64	42	15	803	1,663	51·7	35·6	18·4	33·3	48·3
	16·3	26·8	30·7	26·1]																						

Causation of "Diarrhœa," by Dr. Ballard.

TABLE II.—15,478 Cases of Diarrhœa occurring in the Poor Law Medical Practice and Cholera year 1866), in Quarters, Four

N.B. – I have introduced the numbers for 1866 in *italic* figures for

Weeks	1st Quarter.									2nd Quarter.										3rd			
	1.	2.	3.	4.	5.	6.	7.	8.	9. 10. 11. 12.	13.	14.	15.	16.	17.	18.	19.	20.	21. 22. 23. 24.	25.	26.	27.	28.	29. 30. 31. 32.
Years.																							
1857	5	14	5	8	11	6	8	4	9 9 13 15	6	13	9	10	12	12	4	10	15 11 13 18	32	32	38	47	118 103 87 94
			32				29		46			38			38			57			149		402
1858	6	4	5	7	9	5	9	2	7 11 4 6	7	8	12	10	7	6	8	6	10 13 29 16	36	42	27	36	36 38 37 41
			22				25		28			37			27			68			141		152
1859	4	8	5	4	12	8	8	9	7 12 7 4	7	5	7	9	7	12	10	10	7 16 12 11	14	47	54	98	137 137 118 84
			21				37		30			28			39			46			213		476
1860	3	7	8	4	9	9	11	9	8 7 12 11	8	12	6	7	9	9	11	10	16 11 17 11	7	14	6	22	21 2 19 20
			22				38		38			33			39			55			49		80
1861	4	11	9	11	15	11	10	5	12 5 10 9	10	9	10	11	10	10	14	8	19 13 28 12	26	31	46	42	42 9 76 86
			35				41		36			40			42			72			145		300
1862	10	6	9	10	1	5	10	10	7 8 7 13	13	14	7	8	6	15	14	11	14 9 13 12	19	21	12	24	24 38 36 33
			35				26		35			42			46			48			76		131
1863	14	7	9	12	10	5	7	11	15 6 8 5	9	11	8	6	6	10	7	8	15 21 30 14	18	29	51	93	121 83 84 96
			42				33		34			34			31			80			191		384
1864	6	11	10	10	10	10	12	12	15 10 6 9	11	9	11	10	9	7	12	10	10 9 15 23	25	32	25	29	64 105 87 97
			37				44		40			41			38			57			111		353
1865	9	2	7	8	4	5	5	4	10 8 9 6	6	2	9	13	12	9	13	15	19 12 22 42	46	80	91	95	75 84 41 44
			26				18		33			30			49			95			312		244
1866	*10*	*7*	*13*	*10*	*8*	*10*	*12*	*7*	*9 8 5 7*	*7*	*12*	*4*	*11*	*7*	*15*	*13*	*14*	*9 15 17 26*	*15*	*28*	*55*	*43*	*99 115 165 272*
			40				*37*		*29*			*34*			*49*			*67*			*141*		*651*
1867	4	6	6	4	10	10	15	10	10 2 7 8	20	12	10	7	6	16	17	13	13 14 21 13	20	34	70	76	79 62 74 65
			20				45		27			49			52			61			200		280
1868	11	10	8	14	6	13	10	12	11 20 4 11	17	17	14	13	22	20	14	22	32 14 27 28	62	115	105	108	119 183 205 135
			43				41		46			61			78			101			390		642
1869	12	5	12	13	7	7	10	14	4 9 19 8	11	23	35	17	29	20	25	23	21 17 26 17	18	15	22	79	111 146 108 85
			42				38		40			86			97			81			134		450
13 Periods of 4 Weeks each.	88	91	93	105	104	94	115	102	115 107 106 105	125	135	138	121	135	146	149	146	191 160 253 217	323	492	547	749	947 (1,095) 972 880
			377				415		433			519			576			821			2,111		3,894
Diarrhœal Periods.	Pre-epidemic.																		Epidemic.				

certain MEDICAL RELIEF INSTITUTIONS in ISLINGTON, 1857 to 1869 inclusive (omitting the Week Periods, and Weeks. [All Ages.]

Causation of "Diarrhœa," by Dr. Ballard.

information, but have not included them in the summary calculations.

Quarter.				4th Quarter.																			
33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50.	51.	52.		1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.	Totals of Cases.	Enumerated Population of the Parish.	Cases per 1,000 of Population.
101	123	81	56	29	34	21	22	17	20	16	9	14	6	4	11	7	3	5	5		113	191	932	139	1,375	131,337	10·5
361				106				62				35				20				per cent.	8·2	13·9	67·8	10·1			
55	47	40	36	24	29	12	18	13	13	14	7	8	7	8	10	8	7	1	11		82	203	458	125	868	137,338	6·3
178				83				47				33				27				per cent.	9·5	23·4	52·8	14·4			
84	71	46	47	26	22	22	16	15	14	8	7	4	4	6	12	6	12	4	6		95	167	946	114	1,322	143,339	9·2
248				86				44				26				28				per cent.	7·2	12·6	71·6	8·6			
29	25	35	26	18	33	24	21	21	13	15	13	16	18	15	9	15	8	6	7		106	140	298	177	721	149,340	4·8
115				96				62				58				36				per cent.	14·7	19·4	41·3	24·5			
89	125	96	72	53	35	30	21	26	18	12	19	14	19	10	13	8	6	10	8		122	201	888	184	1,395	155,341 (Census.)	9·0
382				139				75				56				32				per cent.	8·7	14·4	63·7	13·2			
47	40	23	40	44	29	33	42	37	28	24	20	17	20	14	5	9	11	15	20*		109	163	423	262	957	161,184	5·9
150				148				109				56				55				per cent.	11·4	17·0	44·2	27·4			
91	83	53	43	32	30	19	23	16	23	17	11	13	9	8	12	7	5	8	5		118	183	879	157	1,337	167,027	8·0
270				104				67				42				25				per cent.	8·8	13·7	65·7	11·7			
117	50	46	37	38	36	20	23	18	15	15	7	10	8	9	10	9	4	2	9		132	182	751	139	1,204	172,870	6·
250				117				55				37				24				per cent.	11·0	15·1	62·4	11·5			
43	31	39	29	35	45	47	49	47	35	14	16	16	14	16	10	10	10	5	7		83	294	699	249	1,325	178,713	7·4
142				176				112				56				32				per cent.	6·3	22·2	52·8	18·8			
313	*228*	*180*	*140*	*95*	*84*	*90*	*73*	*66*	*44*	*46*	*32*	*31*	*20*	*26*	*23*	*20*	*12*	*11*	4		*113*	*186*	*1,879*	*408*	*2,586*	*184,556*	*14·0*
861				*342*				*188*				*100*				47					*4·4*	*7·2*	*72·6*	*15·8*			
54	66	68	79	57	50	44	32	19	19	16	28	13	7	5	10	12	14	9	5		112	196	844	189	1,341	190,399	7·0
267				183				82				35				40				per cent.	8·4	14·6	62·9	14·1			
112	112	69	47	43	40	31	24	15	15	15	12	14	9	9	8	10	16	15	10		147	400	1,309	172	2,028	196,242	10·3
340				138				57				40				51				per cent.	7·2	19·7	64·5	8·5			
90	67	65	47	47	44	38	35	31	28	21	17	17	21	9	19	12	9	8	12		131	286	949	239	1,605	202,085	8·0
269				164				97				66				41				per cent.	8·2	17·8	59·1	14·9			
912	840	661	559	446	427	341	326	275	241	187	166	156	142	113	129	113	105	83	105		1,350	2,605	9,376	2,146	15,478		
2,972				1,540				869				540				411											
Post-epidemic.																											

* Including the cases in a 53rd week this year.

TABLE III.—13,989 Islington Cases occurring during 11 Years arranged in Periods of the "Diarrhœal Year."

The years within brackets [ ] excluded from the Summary Calculations.

Diarrhœal Years.	13 Periods of 4 Weeks each.													Totals.	Totals of Diarrhœal Periods.			Cases in Periods per cent. of all Cases.			Estimated Population.	Cases per 10,000 of Population.			
	Epidemic Period.					Post-epidemic Period.			Pre-epidemic Period of next Calendar Years.																
Weekly Periods	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.		Epidemic.	Post-epidemic.	Pre-epidemic.	Epidemic.	Post-epidemic.	Pre-epidemic.		Whole Year.	Epidemic Period.	Post-epidemic Period.	Pre-epidemic Period.
Years.																					Year.				
1857–58	57	149	402	361	106	62	35	20	22	25	28	37	27	1,331	1,075	117	139	80·8	8·8	10·4	1857 - 131,337	101	81	9	11
1858–59	68	141	152	178	83	47	33	27	21	37	30	28	39	884	622	107	155	70·4	12·1	17·5	1858 - 137,338	64	45	8	11
1859–60	46	213	476	248	86	44	26	28	22	38	38	33	39	1,337	1,069	98	170	80·0	7·3	12·7	1859 - 143,339	95	75	7	12
1860–61	55	49	80	115	96	62	58	36	35	41	36	40	42	745	395	156	194	53·0	20·9	26·0	1860 - 149,340	50	26	10	13
1861–62	72	145	300	382	139	75	56	32	35	26	35	42	46	1,385	1,038	163	184	74·9	11·8	13·3	1861 - 155,341 (Census.)	89	67	10	12
1862–63	48	76	131	150	148	109	56	55	42	33	34	34	31	947	553	220	174	58·2	23·2	18·4	1862 - 161,184	59	34	14	11
1863–64	80	191	384	270	104	67	42	25	37	44	40	41	38	1,363	1,029	134	200	75·5	9·8	14·7	1863 - 167,027	82	62	8	12
1864–65	57	111	353	250	117	55	37	24	26	18	33	30	49	1,160	888	116	156	76·6	10·0	13·5	1864 - 172,870	67	51	7	9
1865–66	95	312	244	142	176	112	56	32	40	37	29	34	49	1,358	969	200	189	71·3	14·7	13·9	1865 - 178,713	76	54	11	11
[*1866–67*	*67*	*141*	*651*	*861*	*342*	*188*	*100*	*47*	*20*	*45*	*27*	*49*	*52*	*2,590*	*2,062*	*335*	*193*	*79·6*	*12·9*	*7·5*	*1866 - 190,399*	*136*	*108*	*18*	*10*]
1867–68	61	200	280	267	183	82	35	40	43	41	46	61	78	1,417	991	157	269	69·9	11·1	19·0	1867 - 196,242	72	50	8	14
1868–69	101	390	642	340	138	57	40	51	42	38	40	86	97	2,062	1,611	148	303	78·1	7·2	14·7	1868 - 202,085	102	80	7	15
[1869–70	81	134	450	269	164	97	66	41	–	–	–	–	–	–	1,098	204	–	–	–	–	1869 - 207,928	–	53	10	–]
Totals -	740	1,977	3,444	2,703	1,376	772	474	370	365	378	389	466	535	13,989	10,240	1,616	2,133	73·2	11·6	15·2	Average 163,165	78	57	9	12

TABLE IV.—Diarrhœa Cases in the Poor Law Medical Service of Islington. Summary of 6 Calendar Years 1857–1862, Cases distributed into Ages, Diarrhœal Periods, and Four-weekly Periods of occurrence, and thus showing Seasonal Variations in relation to Age. (*See also Coloured Chart.*)

Periods of 4 Weeks.	Months under 1 Year of Age.				Total under 1 Year.	Years of Age, 1 and under 5.				Total 1 and under 5 Years.	Years of Age, 5 and upwards.									Total 5 Years and upwards.	Totals All Ages.	Proportional Prevalence.					Per 10,000 of Average Estimated Population of 1857–62.		
	0–	3–	6–	9–		1–	2–	3–	4–		5–	10–	15–	25–	35–	45–	55–	65–	75 and upwrds.			Under 5 per cent. of All Ages.	Under 1 per cent. of All under 5.	Under 1 per cent. of All Ages.	1 and under 5 per cent. of All Ages.	5 and upwards per cent. of All Ages.	Under 5.	5 Years and upwards.	All Ages.
1st Section. Pre-epidemic period.																											[Estimated Mean Population 19,524	126,789	146,313]
1–4	3	3	7	2	15	12	9	4	2	27	7	4	4	11	7	8	4	2	2	49	91	46·2	35·7	16·5	29·7	53·8	21·5	3·9	6·2
5–8	2	10	3	3	18	13	11	3	1	28	4	3	4	14	11	7	3	6	1	53	99	46·5	39·1	18·2	28·3	53·5	23·6	4·2	6·8
9–12	7	3	2	8	20	16	5	4	5	30	7	2	7	15	8	17	5	9	1	71	121	41·3	40·0	16·5	24·8	58·7	25·6	5·6	8·3
13–16	–	7	5	2	14	16	14	8	6	44	5	12	12	18	13	9	5	1	1	76	134	43·3	24·1	10·4	32·9	56·7	29·7	6·0	9·2
17–20	6	4	3	3	16	27	10	10	5	52	7	4	14	17	20	7	7	5	–	81	149	45·6	23·5	10·7	34·9	54·4	34·8	6·4	10·2
	18	27	20	18	83	84	49	29	19	181	30	25	41	75	59	48	24	23	5	330	594	44·4	31·4	14·0	30·4	55·6	135·2	26·0	40·6
2nd Section. Epidemic period.																													
21–24	2	6	6	6	20	37	15	10	2	64	18	13	13	24	19	31	11	6	2	137	221	38·0	23·8	9·0	29·0	62·0	43·0	10·8	15·1
25–28	13	42	30	24	109	105	44	23	13	185	30	24	26	57	62	34	27	17	4	281	575	51·1	37·1	19·0	32·1	48·9	150·6	22·2	39·3
29–32	29	62	52	42	185	193	92	31	27	343	60	47	70	137	128	73	65	32	10	622	1,150	45·9	35·0	16·1	29·8	54·1	270·4	49·1	78·6
33–36	14	34	55	26	129	172	86	57	22	337	69	53	67	104	93	70	40	35	4	535	1,001	46·6	27·7	12·9	33·7	53·4	238·7	42·2	68·4
37–40	9	18	26	24	77	70	29	29	17	145	27	14	35	46	40	23	12	5	2	204	426	52·1	34·7	18·1	34·0	47 9	113·7	16·1	29·1
	67	162	169	122	520	577	266	150	81	1,074	204	151	211	368	342	231	155	95	22	1,779	3,373	47·3	32·6	15·4	31·9	52·7	816·4	140·3	230·5
Post-epidemic period.																													
41–44	3	11	13	16	43	47	18	18	5	88	22	16	13	28	17	14	11	7	1	129	260	50·4	32·8	16·5	33·9	49·6	67·1	10·2	17·8
45–48	2	5	3	6	16	37	16	10	4	67	13	8	12	20	17	9	4	5	2	90	173	48·0	19·3	9·2	38·8	52·0	42·5	7·1	11·8
49–52	2	7	6	5	20	24	8	5	4	41	12	2	9	6	12	5	6	1	2	55	116	52·6	32·8	17·2	35·4	47·4	31·2	4·3	7·9
	7	23	22	27	79	108	42	33	13	196	47	26	34	54	46	28	21	13	5	274	549	50·1	28·7	14·4	35·7	49·9	140·9	21·6	37·5
	or, raised to the figures which would represent 5 such four-weekly periods (for comparison with the above).																												
	12	38	37	45	132	180	70	55	22	327	78	43	57	90	77	47	35	22	8	457	916						239·7	36·0	62·6
Total of 6 Years	92	212	211	167	682	769	357	211	114	1,451	281	202	286	497	447	307	200	131	32	2,383	4,516	47·2	32·0	15·1	32·1	52·8	1,092·5	188·0	308·7

TABLE V.—Diarrhœa Cases in Poor Law Medical Service of Islington. Cases distributed into Ages, Diarrhœal Periods, and Four-Weekly Periods of Occurrence.

1857.

"Diarrhœal Periods" and Periods of 4 Weeks.	Months of Age under 1 Year.				Total under 1 Year.	Years of Age, 1 and under 5.				Total 1 and under 5 Years.	Years of Age, 5 and upwards.									Total 5 Years and upwards.	Total All Ages.	Proportional Prevalence.					Cases per 10,000 of Estimated Population.		
	0—	3—	6—	9—		1—	2—	3—	4—		5—	10—	15—	25—	35—	45—	55—	65—	75 and upwards.			Under 5 per Cent. of All Ages.	Under 1 per Cent. of All under 5.	Under 1 per Cent. of All Ages.	1 and under 5 per Cent. of All Ages.	5 and upwards per Cent. of All Ages.	Under 5.	5 upwards.	All Ages.
Pre-Epidemic Period.																											[Estimated Population 17,377	113,960	131,337]
1st—4th - - } 5th—8th - - }	Ages imperfectly entered on records.																												
9th—12th - -	3	–	–	1	4	2	–	1	1	4	–	1	2	2	2	4	–	–	–	11	19	42·1	50·0	21·1	21·0	57·9	4·6	1·0	—
(part of period.) 13th—16th - -	–	1	1	–	2	2	6	3	–	11	1	2	2	5	3	1	1	–	–	15	28	46·4	15·4	7·1	39·3	53·6	7·5	1·4	—
17th—20th - -	2	2	–	–	4	5	–	2	–	7	2	–	3	4	5	–	1	–	–	15	26	42·3	36·4	15·4	36·9	57·7	6·3	1·4	—
	5	3	1	1	10	9	6	6	1	22	3	3	7	11	10	5	2	–	–	41	73	43·8	31·3	13·7	30·1	56·2	18·4	3·6	5·6
Epidemic Period.																													
21st—24th - -	–	1	2	–	3	6	1	–	1	8	5	2	3	5	4	7	3	2	–	31	42	26·2	27·3	7·1	19·1	73·8	6·3	2·7	—
25th—28th - -	2	12	7	2	23	15	8	4	3	30	5	9	11	11	16	8	–	3	1	64	117	45·3	43·4	19·7	25·6	54·7	30·5	5·6	—
29th—32nd - -	2	11	7	7	27	38	19	7	4	68	19	20	24	42	46	17	28	12	4	212	307	30·9	28·4	8·8	22·1	69·1	54·7	18·6	—
33rd—36th - -	2	3	12	3	20	34	18	16	6	74	24	23	33	37	27	19	12	4	1	180	274	34·3	21·3	7·3	27·0	65·7	54·1	15·8	—
37th—40th - -	–	2	4	3	9	11	4	3	1	19	1	5	8	10	5	4	3	2	–	38	66	42·4	32·1	13·6	28·8	57·6	16·1	3·3	—
	6	29	32	15	82	104	50	30	15	199	54	59	79	105	98	55	46	23	6	525	806	34·9	29·2	10·2	24·7	65·1	161·7	46·1	61·4
Post-Epidemic Period.																													
41st—44th - -	–	2	2	2	6	9	4	2	1	16	2	5	2	6	3	2	2	–	1	23	45	48·9	27·3	13·3	35·6	51·1	12·7	2·0	—
45th—48th - -	–	–	–	–	–	4	5	1	1	11	–	1	3	2	3	1	1	1	1	13	24	45·8	—	—	45·8	54·2	6·3	1·1	—
49th—52nd - -	–	–	1	–	1	–	2	–	–	2	1	1	–	1	2	–	2	–	–	7	10	30·0	33·3	10·0	20·0	70·0	1·7	0·6	—
	–	2	3	2	7	13	11	3	2	29	3	7	5	9	8	3	5	1	2	43	79	45·6	19·4	8·9	36·7	54·4	20·7	3·8	6·0
	or, raised to the figures which would represent 5 such four-weekly periods (for comparison with the above) :—																												
	–	3	5	3	11	22	18	5	3	48	5	12	8	15	13	5	8	2	3	71	130						34·0	6·2	10·0
Totals of Year -	11	34	36	18	99	126	67	39	18	250	60	69	91	125	116	63	53	24	8	609	958	36·4	28·3	10·3	26·1	63·6	200·8	53·4	—

TABLE V.—Diarrhœa Cases in Poor Law Medical Service of Islington. Cases Distributed into Ages, Diarrhœal Periods, and Four-Weekly Periods of Occurrence—*cont.*

1858.

"Diarrhœal Periods" and Periods of 4 Weeks.	Months of Age under 1 Year.				Total under Year.	Years of Age, 1 and under 5.				Total 1 and under 5 Years.	Years of Age, 5 and upwards.									Total 5 Years and upwards.	Total All Ages.	Proportional Prevalence.					Cases per 10,000 of Estimated Population.		
	0—	3—	6—	9—		1—	2—	3—	4—		5—	10—	15—	25—	35—	45—	55—	65—	75 and upwards.			Under 5 per Cent. of All Ages.	Under 1 per Cent. of All under 5.	Under 1 per Cent. of All Ages.	1 and under 5 per Cent. of All Ages.	5 and upwards per Cent. of All Ages.	Under 5.	5 upwards.	All Ages.
Pre-Epidemic Period.																											[Estimated population 18,241	119,097	137,338]
1st—4th	–	–	–	–	–	3	3	2	–	8	1	–	–	1	3	2	–	–	–	7	15	53·3	–	–	53·3	46·7	4·4	0·6	—
5th—8th	–	2	–	1	3	3	–	–	–	3	–	1	–	3	1	–	–	–	1	6	12	50·0	50·0	25·0	25·0	50·0	3·3	0·5	—
9th—12th	–	–	–	1	1	–	–	–	2	2	1	1	–	2	1	6	2	3	–	16	19	15·8	33·3	5·2	10·5	84·2	1·6	1·3	—
13th—16th	–	3	1	–	4	1	1	1	1	4	2	4	–	1	1	2	2	1	–	13	21	38·1	50·0	19·0	19·1	61·9	4·4	1·1	—
17th—20th	2	–	–	–	2	2	2	1	1	6	–	–	2	3	6	–	2	–	–	13	21	38·1	33·3	9·5	28·6	61·9	4·4	1·1	—
	2	5	1	2	10	9	6	4	4	23	4	6	2	10	12	10	6	4	1	55	88	37·5	30·3	11·4	26·1	62·5	18·1	4·6	6·4
Epidemic Period.																													
21st—24th	–	1	2	2	5	5	4	3	1	13	2	3	1	6	4	5	2	–	1	24	42	42·9	27·7	11·9	31·0	57·1	9·9	2·0	—
25th—28th	5	8	8	4	25	22	10	3	2	37	5	4	1	9	12	9	6	3	2	51	113	55·8	40·3	22·1	33·7	44·2	34·0	4·3	—
29th—32nd	4	8	8	7	27	13	12	2	3	30	5	2	6	9	12	5	5	2	2	48	105	54·3	47·4	25·7	28·6	45·7	31·2	4·0	—
33rd—36th	4	7	11	6	28	21	7	5	4	37	10	8	7	13	11	7	5	2	2	65	130	50·0	43·1	21·5	28·5	50·0	35·6	5·5	—
37th—40th	1	3	4	3	11	6	5	4	1	16	5	3	2	9	7	2	1	–	1	30	57	47·4	40·7	19·3	28·1	52·6	14·8	2·5	—
	14	27	33	22	96	67	38	17	11	133	27	20	17	46	46	28	19	7	8	218	447	51·2	41·9	21·3	29·9	48·8	125·5	18·3	32·5
Post-Epidemic Period.																													
41st—44th	–	1	2	2	5	4	1	1	1	7	1	–	3	8	2	1	2	–	–	17	29	41·4	41·7	17·2	24·2	58·6	6·6	1·4	—
45th—48th	–	1	2	1	4	4	4	2	–	10	3	–	–	–	3	2	–	–	–	8	22	63·6	28·6	18·2	45·4	36·4	7·7	0·7	—
49th—52nd	–	1	2	2	5	2	2	–	1	5	–	–	1	1	4	1	–	–	–	7	17	58·8	50·0	29·4	29·4	41·2	5·5	0·6	—
	–	3	6	5	14	10	7	3	2	22	4	–	4	9	9	4	2	–	–	32	68	52·9	38·9	20·6	32·3	47·1	19·8	2·7	5·0
	or, raised to the figures which would represent 5 such four-weekly periods (for comparison with the above):—																												
	–	5	10	8	23	17	12	5	3	37	7	–	7	15	15	7	3	–	–	54	114						33·0	4·5	8·3
Totals of Year	16	35	40	29	120	86	51	24	17	178	35	26	23	65	67	42	27	11	9	305	603	49·4	40·3	19·9	29·5	50·6	163·4	25·6	—

TABLE V.—Diarrhœa Cases in Poor Law Medical Service of Islington. Cases Distributed into Ages, Diarrhœal Periods, and Four-Weekly Periods of Occurrence—*cont.*

1859.

"Diarrhœal Periods" and Periods of 4 Weeks.	Months of Age under 1 Year.				Total under 1 Year.	Years of Age, 1 and under 5.				Total 1 and under 5 Years.	Years of Age, 5 and upwards.								Total 5 Years and upwards.	Total All Ages.	Proportional Prevalence.					Cases per 10,000 of Estimated Population.		
	0—	3—	6—	9—		1—	2—	3—	4—		5—	10—	15—	25—	35—	45—	55—	—65	75 and upwards.			Under 5 per Cent. of All Ages.	Under 1 per Cent. of All under 5.	Under 1 per Cent. of All Ages.	1 and under 5 per Cent. of All Ages.	5 and upwards per Cent. of All Ages.	Under 5.	5 upwards.	All Ages.
																												[Estimated Population 19,105	124,234	143,339]
Pre-Epidemic Period.																														
1st—4th	1	2	1	1	5	1	2	–	–	3	–	–	1	2	3	2	–	–	–	8	16	50·0	62·5	31·2	18·8	50·0	4·2	0·6	—
5th—8th	2	5	–	2	9	2	1	–	–	3	1	1	–	4	1	–	–	4	–	11	23	52·2	75·0	39·1	13·1	47·8	6·3	0·9	—
9th—12th	1	1	–	2	4	1	1	1	–	3	–	–	–	4	1	2	–	–	–	7	14	50·0	57·1	28·6	21·4	50·0	3·7	0·6	—
13th—16th	–	1	1	–	2	3	2	–	–	5	1	1	5	–	2	2	–	–	1	12	19	36·8	28·6	10·5	26·3	63·2	3·7	1·0	—
17th—20th	1	1	–	1	3	5	2	2	1	10	3	1	1	1	4	–	–	–	–	10	23	56·5	21·4	13·0	43·5	43·5	6·9	0·8	—
	5	10	2	6	23	12	8	3	1	24	5	3	7	11	11	6	–	4	1	48	95	49·5	47·9	24·2	25·3	50·5	24·6	3·9	6·6
Epidemic Period.																														
21st—24th	–	1	1	1	3	6	1	1	–	8	3	2	5	3	5	4	1	1	–	24	35	31·4	27·3	8·6	22·8	68·6	5·8	1·9	—
25th—28th	2	14	6	12	34	31	9	5	3	48	10	8	5	15	10	7	17	8	–	80	162	50·6	41·5	21·0	29·6	49·4	42·9	6·4	—
29th—32nd	3	17	21	12	53	67	27	12	14	120	20	13	21	53	36	27	16	11	2	199	372	46·5	30·6	14·2	32·3	53·5	90·6	16·0	—
33rd—36th	1	7	10	3	21	31	22	8	3	64	15	10	10	17	17	16	12	7	1	105	190	44·7	24·7	11·1	33·6	55·3	44·5	8·5	—
37th—40th	–	4	3	2	9	11	5	6	8	30	5	1	3	7	10	2	2	2	–	32	71	54·9	23·1	12·7	42·2	45·1	20·4	2·6	—
	6	43	41	30	120	146	64	32	28	270	53	34	44	95	78	56	48	29	3	440	830	47·0	30·8	14·5	32·5	53·0	204·1	35·4	57·9
Post-Epidemic Period.																														
41st—44th	–	–	–	–	–	6	1	2	2	11	8	3	1	4	–	2	–	2	–	20	31	35·5	—	—	35·5	64·5	5·7	1·6	—
45th—48th	–	–	–	1	1	3	1	–	1	5	–	1	2	5	1	1	1	1	–	12	18	33·3	16·7	5·6	27·7	66·7	3·1	1·0	—
49th—52nd	–	1	–	2	3	4	–	–	–	4	3	–	3	1	–	1	–	–	1	9	16	43·7	42·9	18·7	25·0	56·3	3·6	0·7	—
	–	1	–	3	4	13	2	2	3	20	11	4	6	10	1	4	1	3	1	41	65	36·9	16·7	6·2	30·7	63·1	12·6	3·3	4·5
	or, raised to the figures that would represent 5 such four-weekly periods (for comparison with the above) :—																													
	–	2	–	5	7	22	3	3	5	33	18	7	10	17	2	7	2	5	2	70	110						21·0	5·7	7·7
Totals of Year	11	54	43	39	147	171	74	37	32	314	69	41	57	116	90	66	49	36	5	529	990	46·6	31·8	14·8	31·8	53·4	241·3	42·6	—

TABLE V.—Diarrhœa Cases in Poor Law Medical Service of Islington. Cases Distributed into Ages, Diarrhœal Periods, and Four-Weekly Periods of Occurrence—*cont.*

1860.

"Diarrhœal Periods" and Periods of 4 Weeks.	Months of Age under 1 Year.				Total under 1 Year.	Years of Age, 1 and under 5.				Total 1 and under 5 Years.	Years of Age, 5 and upwards.									Total 5 Years and upwards.	Total All Ages.	Proportional Prevalence.					Cases per 10,000 of Estimated Population.		
	0—	3—	6—	9—		1—	2—	3—	4—		5—	10—	15—	25—	35—	45—	55—	65—	75 and upwards.			Under 5 per Cent. of All Ages.	Under 1 per Cent. of All under 5.	Under 1 per Cent. of All Ages.	1 and under 5 per Cent. of All Ages.	5 and upwards per Cent. of All Ages.	Under 5.	5 upwards.	All Ages.
																											[Estimated Population 19,969	129,371	149,340]
Pre-Epidemic Period.																													
1st—4th - -	–	–	1	–	1	–	1	2	–	3	3	3	1	1	1	1	1	–	1	12	16	25·0	25·0	6·2	18·8	75·0	2·0	0·9	—
5th—8th - -	–	–	1	–	1	–	4	–	–	4	1	1	2	3	3	4	2	–	–	16	21	23·8	20·0	4·8	19·0	76·2	2·5	1·2	—
9th—12th - -	–	1	2	1	4	1	1	–	2	4	2	–	2	1	3	1	2	2	–	13	21	38·1	50·0	19·0	19·1	61·9	4·0	1·0	—
13th—16th - -	–	1	2	1	4	1	1	–	–	2	–	1	–	2	2	2	–	–	–	7	13	41·5	66·7	30·8	10·7	58·5	3·0	0·5	—
17th—20th - -	1	–	–	1	2	–	–	3	1	4	–	3	2	3	2	4	1	1	–	16	22	27·3	33·3	9·1	18·2	72·7	3·0	1·2	—
	1	2	6	3	12	2	7	5	3	17	6	8	7	10	11	12	6	3	1	64	93	31·2	41·4	12·9	18·3	68·8	14·5	4·9	6·2
Epidemic Period.	2	1	–	3	6	8	3	3	–	14	2	2	–	1	3	4	–	–	–	12	32	62·4	30·0	18·7	43·7	37·6	10·0	0·9	—
21st—24th - -	2	2	–	1	5	5	1	3	2	11	1	–	–	4	4	3	2	1	–	15	31	51·6	31·2	16·1	35·5	48·4	8·0	1·2	—
25th—28th - -	2	–	–	1	3	9	10	2	3	24	2	4	3	7	7	3	5	1	1	33	60	45·0	11·1	5·0	40·0	55·0	13·5	2·6	—
29th—32nd - -	1	6	4	4	15	15	7	4	1	27	5	2	7	5	6	4	1	3	–	33	75	56·0	35·7	20·0	36·0	44·0	21·0	2·6	—
33rd—36th - -	4	2	3	4	13	11	4	5	1	21	3	–	7	6	8	2	–	1	1	28	62	54·8	38·2	21·0	33·8	45·2	17·0	2·2	—
37th—40th - -	11	11	7	13	42	48	25	17	7	97	13	8	17	23	28	16	8	6	2	121	260	53·5	30·2	16·2	37·3	46·5	69·6	9·4	17·4
Post-Epidemic Period.	1	1	1	2	5	5	1	5	–	11	3	1	2	2	3	1	4	3	–	19	35	45·7	31·2	14·3	31·4	54·3	8·0	1·5	–
41st—44th - -	1	2	–	1	4	7	3	2	–	12	5	2	–	6	3	1	2	–	1	20	36	44·4	25·0	11·1	33·3	55·6	8·0	1·5	—
45th—48th - -	–	3	–	–	3	5	1	2	–	8	2	–	4	–	2	1	–	–	1	10	21	52·4	27·3	14·3	38·1	47·6	5·5	0·8	—
49th—52nd - -	2	6	1	3	12	17	5	9	–	31	10	3	6	8	8	3	6	3	2	49	92	46·7	27·9	13·0	33·7	53·3	21·5	3·8	6·2
	or, raised to the figures which would represent 5 such four-weekly periods (for comparison with the above) :—																												
	3	10	2	5	20	28	8	15	—	51	17	5	10	13	13	5	10	5	3	81	152						35·5	6·3	10·2
Totals of Year -	14	19	14	19	66	67	37	31	10	145	29	19	30	41	47	31	20	12	5	234	445	47·4	31·3	14·8	32·6	52·6	105·7	18·1	—

TABLE V.—Diarrhœa Cases in Poor Law Medical Service of Islington. Cases Distributed into Ages, Diarrhœal Periods, and Four-Weekly Periods of Occurrence—*cont.*

1861.

"Diarrhœal Periods" and Periods of 4 Weeks.	Months of Age under 1 Year.				Total under 1 Year.	Years of Age, 1 and under 5.				Total 1 and under 5 Years.	Years of Age, 5 and upwards.									Total 5 Years and upwards.	Total All Ages.	Proportional Prevalence.					Cases per 10,000 of Estimated Population		
	0—	3—	6—	9—		1—	2—	3—	4—		5—	10—	15—	25—	35—	45—	55—	65—	75 and upwards.			Under 5 per Cent. of All Ages.	Under 1 per Cent. of All under 5.	Under 1 per Cent. of All Ages.	1 and under 5 per Cent. of All Ages.	5 and upwards per Cent. of All Ages.	Under 5.	5 upwards.	All Ages.
																											[Population 20,833	134,508	155,341]
Pre-Epidemic Period.																													
1st—4th	1	1	2	1	5	–	1	–	1	2	2	1	–	6	–	2	3	1	–	15	22	31·8	71·4	22·7	9·1	68·2	3·4	1·1	—
5th—8th	–	2	2	–	4	4	4	2	1	11	1	–	–	2	4	3	1	1	–	12	27	55·6	26·7	14·8	40·8	44·4	7·2	0·9	—
9th—12th	–	1	–	1	2	5	–	2	–	7	2	–	2	1	1	3	–	3	1	13	22	40·9	22·2	9·1	31·8	59·1	4·3	1·0	—
13th—16th	–	–	–	–	–	6	–	1	3	10	–	1	4	4	5	–	2	–	–	16	26	38·5	–	–	38·5	61·5	4 8	1·2	—
17th—20th	–	1	–	–	1	6	3	–	1	10	1	–	2	2	2	2	2	–	–	11	22	50·0	9·1	4·5	45·5	50·0	5·3	0·8	—
	1	5	4	2	12	21	8	5	6	40	6	2	8	15	12	10	8	5	1	67	119	43·7	23·1	10·1	33·6	56·3	25·0	5·0	7·7
Epidemic Period.																													
21st—24th	–	–	1	–	1	4	3	3	–	10	2	3	3	5	3	6	4	2	1	29	40	27·5	9·1	2·5	25·0	72·5	5·3	2·1	—
25th—28th	1	2	4	2	9	23	6	4	2	35	7	2	7	12	16	5	2	2	1	54	98	44·9	20·5	9·2	35·7	55·1	21·1	4 0	—
29th—32nd	11	16	10	12	49	47	15	6	3	71	10	5	10	19	12	17	9	3	1	86	206	58·3	40·8	23·8	34·5	41·7	57·6	6·4	—
33rd—36th	4	10	9	7	30	53	22	17	6	98	13	5	7	22	21	19	6	13	–	106	234	54·7	23·4	12·8	41·9	45·3	61·4	7·9	—
37th—40th	2	4	7	4	17	17	4	3	3	27	6	3	13	10	4	7	1	–	–	44	88	50·0	38·6	19·3	30·7	50·0	21·1	3·3	—
	18	32	31	25	106	144	50	33	14	241	38	18	40	68	56	54	22	20	3	319	666	52·1	30·5	15·9	36·2	47·9	166 6	23·7	42·9
Post-Epidemic Period.																													
41st—44th	–	4	3	2	9	10	7	5	1	23	4	3	3	4	3	4	3	2	–	26	58	55·2	28·1	15·5	39·7	44·8	15·4	1·9	—
45th—48th	–	–	–	1	1	9	2	3	1	15	3	2	4	4	5	3	–	1	–	22	38	42·1	6·2	2·6	39·5	57·9	7·7	1·6	—
49th—52nd	1	1	–	–	2	9	1	2	2	14	1	–	–	3	1	1	1	1	–	8	24	66·7	12·5	8·3	58·4	33·3	7·7	0·6	—
	1	5	3	3	12	28	10	10	4	52	8	5	7	11	9	8	4	4	–	56	120	53·3	18·7	10·0	43·3	46·7	30·7	4·2	7·7
	or, raised to the figures which would represent 5 such four-weekly periods (for comparison with the above) :—																												
	2	8	5	5	20	47	17	17	7	88	13	8	12	18	15	13	7	7	–	93	201						51·8	6·9	12·9
Totals of Year	20	42	38	30	130	193	68	48	24	333	52	25	55	94	77	72	34	29	4	442	905	51·2	28·1	14·4	36·8	48·8	222·2	32·9	—

TABLE V.—Diarrhœa Cases in Poor Law Medical Service of Islington. Cases Distributed into Ages, Diarrhœal Periods, and Four-Weekly Periods of Occurrence—*cont.*

1862.

"Diarrhœal Periods" and Periods of 4 Weeks.	Months of Age under 1 Year.				Total under 1 Year.	Years of Age, 1 and under 5.				Total 1 and under 5 Years.	Years of Age, 5 and upwards.									Total 5 Years and upwards.	Total All Ages.	Proportional Prevalence.					Cases per 10,000 of Estimated Population.		
	0—	3—	6—	9—		1—	2—	3—	4—		5—	10—	15—	25—	35—	45—	55—	65—	75 and upwards.			Under 5 per Cent. of All Ages.	Under 1 per Cent. of All under 5.	Under 1 per Cent. of All Ages.	1 and under 5 per Cent. of All Ages.	5 and upwards per Cent. of All Ages.	Under 5.	5 upwards.	All Ages.
Pre-Epidemic Period.																											[Estimated Population, 21,619	139,565	161,184]
1st—4th	1	–	3	–	4	8	2	–	1	11	1	–	2	1	–	1	–	1	1	7	22	68·2	26·7	18·2	50·0	31·8	6·9	0·5	—
5th—8th	–	1	–	–	1	4	2	1	–	7	1	–	2	2	2	–	–	1	–	8	16	50·0	12·5	6·2	43·8	50·0	3·7	0·6	—
9th—12th	3	–	–	2	5	7	3	–	–	10	2	–	1	5	–	1	1	1	–	11	26	57·7	33·3	19 2	38·5	42·3	6·9	0·8	—
13th—16th	–	1	–	1	2	3	4	3	2	12	1	3	1	6	–	2	–	–	–	13	27	51·9	14·3	7·4	44·5	48·1	6·5	0·9	—
17th—20th	–	–	3	1	4	9	3	2	1	15	1	–	4	4	1	1	1	4	–	16	35	54·3	21·1	11·4	42·9	45·7	8·8	1·1	—
	4	2	6	4	16	31	14	6	4	55	6	3	10	18	3	5	2	7	1	55	126	56·3	22·5	12·7	43·6	43·7	32·8	3·9	9·0
Epidemic Period.																													
21st—24th	–	2	–	–	2	8	3	–	–	11	4	1	1	4	–	5	1	1	–	17	30	43·3	15·4	6·7	36·6	56·7	6·0	1·2	—
25th—28th	1	4	5	3	13	9	10	4	1	24	2	1	2	6	4	2	–	–	–	17	54	68·5	35·1	24·1	44·4	31·5	17·1	1·2	—
29th—32nd	7	10	6	3	26	19	9	1	1	30	4	3	6	7	15	4	2	3	–	44	100	56·0	46·4	26·0	30·0	44·0	25·9	3·2	—
33rd—36th	2	1	9	3	15	18	10	7	2	37	2	5	3	10	11	5	4	6	–	46	98	53·1	28·8	15·3	37·8	46·9	24·1	3·3	—
37th—40th	2	3	5	8	18	14	7	8	3	32	7	2	2	4	6	6	5	–	–	32	82	61·0	36·0	22·0	39·0	39·0	23·1	2·3	—
	12	20	25	17	74	68	39	20	7	134	19	12	14	31	36	22	12	10	–	156	364	57·1	35·6	20·3	36·8	42·9	96·2	11·2	26·1
Post-Epidemic Period.																													
41st—44th	2	3	5	8	18	13	4	3	–	20	4	4	2	4	6	4	–	–	–	24	62	61·3	47·4	29·0	32·3	39·7	17·6	1·7	—
45th—48th	1	2	1	2	6	10	1	2	1	14	2	2	3	3	2	1	–	2	–	15	35	57·1	30·0	17·1	40·0	42·9	9·3	1·1	—
49th—52nd	1	1	3	1	6	4	2	1	1	8	5	1	1	–	3	1	3	–	–	14	28	50·0	42·9	21·4	28·6	50·0	6·4	1·0	—
	4	6	9	11	30	27	7	6	2	42	11	7	6	7	11	6	3	2	–	53	125	57·6	41·7	24·0	33·6	42·4	33·3	3·8	7·8
	or, raised to the figures which would represent 5 such four-weekly periods (for comparison with the above) :—																												
	7	10	15	18	50	45	12	10	3	70	18	12	10	12	18	10	5	3	–	88	208						55·5	6·3	12·9
Totals of Year	20	28	40	32	120	126	60	32	13	231	36	22	30	56	50	53	17	19	1	264	615	57·1	34·2	19·5	37·6	42·9	162·4	18·9	—

TABLE VI.—Showing the Number of Cases of Diarrhœa which were recorded each Week during the Epidemic Season of each Year from 1881 to 1887 at the Stations established by the Corporation of Leicester, specifying Ages, and Proportional and Actual Incidence upon the several Ages.

1881.

Weeks ended	Under 1 Year.						1 and under 5 Years.						Total under 5 Years of Age.	5 Years and upwards.						Total of Specified Ages.	Proportional Incidence on Age.					Actual Incidence on Age per 10,000 Population.				
	Stations.					Total.	Stations.					Total.		Stations.					Total.		Under 5, per cent. of All Ages.	Under 1, per cent. of All under 5.	Under 1, per cent. of All Ages.	1 and under 5, per cent. of All Ages.	5 and upwards, per cent. of All Ages.	Under 1.	1 and under 5.	Under 5.	5 and upwards.	All Ages.
	Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.		Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.			Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.												
																										[Estimated Population				
																										3,961	13,418	17,379	105,767	123,146]
*July 23 - -	3	5	4	7	15	34	17	10	13	20	18	78	112	58	46	24	57	95	280	392	28·6	30·4	8·7	19·9	71·4	86	58	64	26	32
„ 30 - -	14	34	8	24	28	108	36	72	41	64	72	285	393	143	196	97	113	230	779	1,172	33·5	27·5	9·2	24·3	66·5	273	212	226	74	95
August 6 - -	7	37	1	24	19	88	41	86	16	55	65	263	351	90	278	59	146	215	788	1,139	30·8	25·1	7·7	23·1	69·2	222	196	202	75	92
„ 13 -	9	30	5	13	19	76	32	87	38	61	57	275	351	103	373	101	134	254	965	1,316	26·7	21·7	5·8	20·9	73·3	192	205	202	91	107
Total 29th to 32nd week of year -	33	106	18	68	81	306	126	255	108	200	212	901	1,207	394	893	281	450	794	2,812	4,019	30·3	25·4	7·6	22·7	69·7	773	671	694	266	326
August 20 - -	4	15	2	5	10	36	16	77	9	23	57	182	218	61	221	25	70	159	536	754	28·9	16·5	4·8	24·1	71·1	91	136	125	51	61
„ 27 -	–	6	2	2	4	14	6	43	11	7	25	92	106	36	161	31	41	69	338	444	23·9	13·2	3·2	20·7	76·1	35	69	61	32	36
September 3 -	–	6	–	2	4	12	–	25	4	7	23	59	71	16	99	17	18	53	203	274	25·9	16·9	4·4	21·5	74·1	30	44	41	19	22
„ 10 -	–	2	–	3	–	5	4	16	3	6	11	40	45	2	49	4	14	43	112	157	28·7	11·1	3·2	25·5	71·3	13	30	26	11	13
Total 33rd to 36th week of year -	4	29	4	12	18	67	26	161	27	43	116	373	440	115	530	77	143	324	1,189	1,629	27·0	16·2	4·1	22·9	73·0	169	279	253	113	132
September 17 -	–	–	1	1	4	6	3	14	–	4	7	28	34	1	39	6	20	20	86	120	28·3	17·6	5·0	23·3	71·7	15	21	20	8	10
„ 24 -	–	1	–	–	–	1	1	10	–	7	5	23	24	2	26	4	13	18	63	87	27·6	4·2	1·1	26·5	72·4	3	17	14	6	7
October 1 - -	1	2	–	–	3	6	–	3	–	2	9	14	20	3	17	–	1	26	47	67	29·9	30·0	9·0	20·9	70·1	15	10	12	4	4
Total 37th to 39th week of year -	1	3	1	1	7	13	4	27	–	13	21	65	78	6	82	10	34	64	196	274	28·5	16·6	4·7	23·8	71·5	33	48	46	18	21
Total whole epidemic period included -	38	138	23	81	106	386	156	443	135	256	349	1,339	1,725	515	1,505	368	627	1,182	4,197	5,922	29·1	22·4	6·5	22·6	70·9	975	998	993	397	479

* Observations commenced in middle of 1st week of 3rd four-week division of "epidemic period" (29th week of year). Epidemic had lasted a week or two before stations were opened. Observations closed one week before close of "epidemic period" (39th week of year).

TABLE VI.—Showing the Number of Cases of Diarrhœa which were recorded each week during the Epidemic Season of each Year from 1881 to 1887 at the Stations established by the Corporation of Leicester, specifying Ages and Proportional and Actual Incidence upon the several Ages—*continued.*

1882.

Weeks ended	Under 1 Year. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	1 and under 5 Years. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total under 5 Years of Age.	5 Years and upwards. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total of Specified Ages.	Proportional Incidence on Age. Under 5, per cent. of All Ages.	Under 1, per cent. of All under 5.	Under 1, per cent. of All Ages.	1 and under 5, per cent. of All Ages.	5 and upwards, per cent. of All Ages.	Actual Incidence on Age per 10,000 Population. Under 1.	1 and under 5.	Under 5.	5 and upwards.	All Ages.
																										[Estimated Population				
																										4,061	13,759	17,820	108,455	126,275]
* July 29 - -	5 days 4	6 days 5	5 days –	6 days 3	5 days 6	18	9	22	8	4	11	54	72	16	67	15	18	37	153	225	32·0	25·0	8·0	24·0	68·0	44	39	40	14	18
August 5 - -	4	17	2	4	7	34	17	46	16	14	17	110	144	45	126	26	19	68	284	428	33·6	23·6	7·9	25·7	66·4	84	80	81	26	34
„ 12 - -	1	16	1	4	8	30	14	51	4	18	34	121	151	23	150	23	34	113	343	494	30·6	19·9	6·1	24·5	69·4	74	88	85	32	39
Total 29th to 31st week of year -	9	38	3	11	21	82	40	119	28	36	62	285	367	84	343	64	71	218	780	1,147	32·0	22·6	7·1	24·9	68·0	202	207	206	72	91
August 19 - -	2	23	4	7	17	53	23	88	11	28	50	200	253	40	231	38	53	171	533	786	32·2	20·9	6·7	25·5	67·8	131	145	142	49	62
„ 26 - -	1	12	3	2	14	32	21	47	12	23	48	151	183	47	159	37	45	176	464	647	28·3	17·5	4·9	23·4	71·7	79	110	103	43	51
September 2 -	–	7	1	4	9	21	6	27	6	13	40	92	113	21	129	8	21	118	297	410	27·6	18·6	5·1	22·5	72·4	52	67	63	27	32
„ 9 - -	–	2	–	–	4	6	10	14	2	–	17	43	49	17	62	4	8	49	140	189	25·9	12·2	3·2	22·7	74·1	15	31	27	13	15
Total 32nd to 35th week of year -	3	44	8	13	44	112	60	176	31	64	155	486	598	125	581	87	127	514	1,434	2,032	29·4	18·7	5·5	23·9	70·6	277	353	335	132	160
September 16 -	–	2	–	1	3	6	3	10	5	5	18	41	47	5	59	14	13	53	144	191	24·6	12·8	3·1	21·5	75·4	15	30	26	13	15
„ 23 - -	1	1	–	1	4	7	2	12	3	6	18	41	48	4	44	6	2	48	104	152	31·6	14·6	4·6	27·0	68·4	17	30	27	10	12
„ 30 - -	–	3	–	–	1	4	–	2	1	–	5	8	12	10	26	3	–	14	53	65	18·5	33·3	6·2	12·3	81·5	10	6	7	5	5
October 7 - -	–	2	–	–	–	2	–	2	–	–	2	4	6	–	11	–	–	4	15	21	28·6	33·3	9·5	19·1	71·4	5	3	3	1	2
Total 36th to 40th week of year -	1	8	–	2	8	19	5	26	9	11	43	94	113	19	140	23	15	119	316	429	25·9	16·8	4·4	21·5	74·1	47	69	63	29	34
Total whole epidemic period included -	13	90	11	26	73	213	105	321	68	111	260	865	1,078	228	1,064	174	213	851	2,530	3,608	29·9	19·8	5·9	24·0	70·1	526	629	604	233	285

* Observations commenced with 2nd week of 3rd four-weekly division of "epidemic period" (29th week of year). Epidemic had lasted two or three weeks before stations were opened.
Observations ended with close of "epidemic period" (40th week of year).

TABLE VI.—Showing the Number of Cases of Diarrhœa which were recorded each week during the Epidemic Season of each Year from 1881 to 1887 at the Stations established by the Corporation of Leicester, specifying Ages, and Proportional and Actual Incidence upon the several Ages—*continued.*

1883.

Weeks ended	Under 1 Year. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	1 and under 5 Years. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total under 5 Years of Age.	5 Years and upwards. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total of Specified Ages.	Proportional Incidence on Age. Under 5, per cent. of All Ages.	Under 1, per cent. of All under 5.	Under 1, per cent. of All Ages.	1 and under 5, per cent. of All Ages.	5 and upwards, per cent. of All Ages.	Actual Incidence on Age per 10,000 Population. Under 1.	1 and under 5.	Under 5.	5 and upwards.	All Ages.
																										[Estimated Population 4,165	14,108	18,273	111,210	129,483]
*June 9 - -	–	–	–	–	1	1	2	1	–	1	1	5	6	1	5	–	2	11	19	25	24·0	16·6	4·0	20·0	76·0	2	4	3	2	2
„ 16 - -	–	–	–	–	–	–	2	2	–	2	3	9	9	4	5	–	3	7	19	28	32·1	–	–	32·1	67·9	–	6	5	2	2
Total 23rd & 24th week of year -	–	–	–	–	1	1	4	3	–	3	4	14	15	5	10	–	5	18	38	53	28·3	6·6	1·9	26·4	71·7	2	10	8	4	4
June 23 - -	–	–	–	–	1	1	1	4	–	2	10	17	18	7	8	–	3	19	37	55	32·7	5·5	1·8	30·9	67·3	2	12	10	3	4
„ 30 - -	–	1	1	–	5	7	1	11	2	–	14	28	35	5	14	2	8	26	55	90	38·9	20·0	7·8	31·1	61·1	17	20	19	5	7
July 7 - -	–	6	–	1	7	14	4	18	6	9	26	63	77	20	59	5	20	75	179	256	30·1	18·2	5·5	24·6	69·9	34	45	42	16	20
„ 14 - -	1	7	1	1	9	19	12	37	2	3	34	88	107	36	94	9	18	88	245	352	30·4	17·8	5·4	25·0	69·6	46	62	59	22	27
Total 25th to 28th week of year -	1	14	2	2	22	41	18	70	10	14	84	196	237	68	175	16	49	208	516	753	31·5	17·3	5·4	26·1	68·5	99	139	120	46	58
July 21 - -	4	9	1	5	5	24	18	28	2	9	26	83	107	32	70	24	13	61	200	307	34·9	22·4	7·8	27·1	65·1	58	59	59	18	24
„ 28 - -	–	9	1	5	7	22	6	28	3	17	45	99	121	27	78	9	25	69	208	329	36·9	18·2	6·7	30·2	63·1	53	70	66	19	25
August 4 - -	3	15	–	1	10	29	15	33	6	10	24	88	117	38	87	10	20	92	247	364	32·1	24·8	8·0	24·1	67·9	70	62	65	22	28
„ 11 -	1	15	1	–	5	22	7	56	–	9	27	99	121	27	128	16	23	56	250	371	32·6	18·2	5·9	26·7	67·4	53	70	66	22	29
Total 29th to 32nd week of year -	8	48	3	11	27	97	46	145	11	45	122	369	466	124	363	59	81	278	905	1,371	34·0	20·8	7·1	26·9	66·0	234	261	256	81	106
August 18 - -	3	13	2	2	4	24	16	55	8	14	21	114	138	44	114	24	31	74	287	425	32·5	17·4	5·6	26·9	67·5	58	81	76	26	33
„ 25 - -	1	12	–	7	6	26	14	49	8	19	41	131	157	42	135	19	37	114	347	504	31·2	16·6	5·2	26·0	68·8	62	93	86	31	39
September 1 -	2	11	4	4	18	39	17	53	7	18	40	135	174	58	175	30	41	137	441	615	28·3	22·4	6·3	22·0	71·7	94	96	95	40	47
„ 8 -	1	18	–	2	2	23	9	38	2	8	39	96	119	23	113	3	24	81	244	363	32·8	19·3	5·1	27·7	67·2	55	68	65	22	28
Total 33rd to 36th week of year -	7	54	6	15	30	112	56	195	25	59	141	476	588	167	537	76	133	406	1,319	1,907	30·8	19·0	5·9	24·9	69·2	269	338	322	119	147
September 15 -	3	5	3	–	4	15	11	31	4	6	17	69	84	31	64	22	21	44	182	266	31·6	17·9	5·6	26·0	68·4	36	49	46	16	21
„ 22 -	–	5	–	–	1	6	7	16	3	5	10	41	47	19	67	11	12	52	161	208	22·6	12·8	2·9	19·7	77·4	14	29	26	14	16
„ 29 -	–	4	–	–	2	6	3	19	3	6	23	54	60	10	53	9	8	46	126	186	32·3	10·0	3·2	29·1	67·7	14	38	33	11	14
October 6 - -	–	3	–	–	–	3	–	11	–	–	–	11	14	–	28	–	–	–	28	42	33·3	21·4	7·1	26·2	66·7	7	8	8	3	3
Total 37th to 40th week of year -	3	17	3	–	7	30	21	77	10	17	50	175	205	60	212	42	41	142	497	702	29·2	14·6	4·3	24·9	70·8	71	124	113	44	54
Total whole epidemic period included - -	19	133	14	28	87	281	145	490	56	138	401	1,230	1,511	424	1,297	193	309	1,052	3,275	4,786	31·6	18·6	5·9	25·7	68·4	675	872	829	294	369

TABLE VI.—Showing the Number of Cases of Diarrhœa which were recorded each week during the Epidemic Season of each Year from 1881 to 1887 at the Stations established by the Corporation of Leicester, specifying Ages, and Proportion and Actual Incidence upon the several Ages—*continued.*

1884.

Weeks ended	Under 1 Year. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	1 and under 5 Years. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total under 5 Years of Age.	5 Years and upwards. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total of Specified Ages.	Proportional Incidence on Age. Under 5, per cent. of All Ages.	Under 1, per cent. of all under 5.	Under 1, per cent. of All Ages.	1 and under 5, per cent. of All Ages.	5 and upwards, per cent. of All Ages.	Actual Incidence on Age per 10,000 Population. Under 1.	1 and under 5.	Under 5.	5 and upwards.	All Ages.
	5 days	6 days	4 days	6 days	6 days.																					[Estimated Population 4,270	14,467	18,737	114,036	132,773]
*28th week of year, July 12 -	8	13	2	8	7	38	21	40	5	20	16	102	140	34	138	17	44	84	317	457	30·6	27·1	8·3	22·3	69·4	89	71	75	29	34
July 19 - -	13	25	11	11	17	77	24	129	14	29	54	250	327	122	397	37	80	212	848	1,175	27·8	23·5	6·6	21·2	72·2	180	173	175	74	87
„ 26 - -	10	24	7	8	15	64	49	85	16	27	49	226	290	149	331	49	72	167	768	1,058	27·4	22·1	6·0	21·4	72·6	150	156	155	67	80
August 2 - -	9	17	3	3	5	37	31	54	8	29	29	151	188	119	233	31	86	171	640	828	22·7	19·7	4·5	18·2	77·3	87	104	100	56	62
„ 9 - -	5	20	3	9	9	46	15	72	15	28	48	178	224	134	300	49	77	234	794	1,018	22·0	20·5	4·5	17·5	78·0	108	123	120	70	77
Total 29th to 32nd week of year -	37	86	24	31	46	224	119	340	53	113	180	805	1,029	524	1,261	166	315	784	3,050	4,079	25·2	21·8	5·5	19·7	74·8	525	556	550	267	306
August 16 - -	9	17	7	8	15	56	53	124	23	47	56	303	359	261	432	111	159	368	1,331	1,690	21·2	15·6	3·3	17·9	78·8	131	209	192	117	127
„ 23 -	9	25	4	11	15	64	44	135	22	65	84	350	414	216	466	113	167	356	1,318	1,732	23·9	15·5	3·7	20·2	76·1	150	242	221	116	130
„ 30 - -	6	9	3	9	8	35	31	126	23	41	58	279	314	182	341	109	97	304	1,033	1,347	23·3	11·1	2·6	20·7	76·7	82	193	168	91	101
September 6 -	4	11	–	3	7	25	8	42	7	17	37	111	136	77	191	30	65	162	525	661	20·6	18·4	3·8	16·8	79·4	59	77	73	46	50
Total 33rd to 36th week of year -	28	62	14	31	45	180	136	427	75	170	235	1,043	1,223	736	1,430	363	488	1,190	4,207	5,430	22·3	14·7	3·3	19·0	77·7	422	721	654	370	408
September 13 -	1	3	† –	–	6	10	5	14	† 6	8	21	54	64	32	108	† 2	29	112	283	347	18·4	15·6	2·9	15·5	81·6	23	37	34	25	26
„ 20 -	–	–	–	3	1	4	3	15	2	9	20	49	53	20	93	13	20	88	234	287	18·5	7·5	1·4	17·1	81·5	9	34	28	21	22
„ 27 -	–	3	–	–	2	5	1	12	3	6	9	31	36	6	87	4	22	67	186	222	16·2	13·9	2·3	13·9	83·8	12	21	19	16	17
October 4 - -	–	1	–	–	–	1	–	3	–	3	1	7	8	–	7	–	13	6	26	34	23·5	12·5	2 9	20·6	76·5	2	5	4	2	3
Total 37th to 40th week of year -	1	7	–	3	9	20	9	44	11	26	51	141	161	58	295	19	84	273	729	890	18·2	12·4	2·2	16·0	81·8	46	97	85	64	68
Total whole epidemic period included - -	74	168	40	73	107	462	285	851	144	329	482	2,091	2,553	1,352	3,124	565	931	2,331	8,303	10,856	23·5	18·1	4·3	19·2	76·5	1,082	1,445	1,364	730	816

* Observations commenced in beginning of 8th week of "epidemic-period" (28th week of year). Stations opened just before the worst of the mortality commenced. Probably the opening of them was not generally known, or the numbers in first week on table would have been higher. Observations closed with close of epidemic-period (40th week of year).

† Five days omitted from record in book.

TABLE VI.—Showing the Number of Cases of Diarrhœa which were recorded each Week during the Epidemic Season of each Year from 1881 to 1887, at the Stations established by the Corporation of Leicester, specifying Ages, and Proportional and Actual Incidence upon the several Ages—*continued.*

1885.

Weeks ended	Under 1 Year. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	1 and under 5 Years. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total under 5 Years of Age.	5 Years and upwards. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total of Specified Ages.	Proportional Incidence on Age. Under 5, per cent. of All Ages.	Under 1, per cent. of All under 5.	Under 1, per cent. of All Ages.	1 and under 5, per cent. of All Ages.	5 and upwards, per cent. of All Ages.	Actual Incidence on Age per 10,000 Population. Under 1.	1 and under 5.	Under 5.	5 and upwards.	All Ages.
	2 days.	2 days.		2 days.	3 days.																					[Estimated Population 4,379	14,834	19,213	116,934	136,147]
* July 25 - -	–	4	†	2	2	8	3	7	†	4	6	20	28	16	29	†	24	35	104	132	21·2	28·6	6·1	15·1	78·8	18	13	15	9	10
Aug. 1 - -	8	14	6	5	5	38	24	47	13	24	30	138	176	76	215	49	99	170	609	785	22·4	21·6	4·8	17·6	77·6	87	93	92	52	58
„ 8 - -	4	12	4	7	13	40	9	43	9	26	28	115	155	48	175	38	80	158	499	654	23·7	25·8	6·1	17·6	76·3	91	78	81	43	48
„ 15 - -	2	12	3	5	4	26	12	53	12	18	20	115	141	54	145	27	65	131	422	563	25·0	18·4	4·6	20·4	75·0	59	78	68	36	41
Total 29th to 32nd week of year -	14	42	13	19	24	112	48	150	34	72	84	388	500	194	564	114	268	494	1,634	2,134	23·4	22·4	5·2	18·2	76·6	255	262	256	140	157
Aug. 22 - -	2	4	2	3	5	16	6	26	8	17	19	76	92	25	136	25	48	94	328	420	21·9	17·4	3·8	18·1	78·1	37	51	48	28	31
„ 29 - -	1	4	2	4	2	13	8	25	5	5	11	54	67	25	94	17	26	69	231	298	22·5	19·4	4·4	18·1	77·5	30	36	35	20	22
Sept. 5 - -	2	5	1	–	–	8	6	17	2	3	13	41	49	11	53	5	18	55	142	191	25·7	16·3	4·2	21·5	74·3	18	28	26	12	14
„ 12 - -	1	3	–	–	–	4	3	1	1	5	6	16	20	5	47	4	13	32	101	121	16·5	20·0	3·3	13·2	83·5	9	11	10	8	9
Total 33rd to 36th week of year -	6	16	5	7	7	41	23	69	16	22	49	187	228	66	330	51	105	250	802	1,030	22·1	18·0	4·0	18·1	77·9	94	126	119	68	76
Sept. 19 - -	–	1	‡	–	–	1	1	7	‡	2	6	16	17	4	39	‡	10	34	87	104	16·3	6·9	1·0	15·3	83·7	2	11	9	7	8
„ 26 - -	–	1	–	1	–	2	–	5	–	4	–	9	11	2	27	–	12	3	44	55	20·0	18·2	3·6	16·4	80·0	4	6	6	3	4
Oct. 3 - -	–	1	–	–	–	1	–	3	–	–	–	3	4	–	12	–	2	–	14	18	22·2	25·0	5·5	16·7	77·8	2	3	2	1	1
Total 37th to 39th week of year -	–	3	–	1	–	4	1	15	–	6	6	28	32	6	78	–	24	37	145	177	18·1	12·5	2·3	15·8	81·9	8	20	17	11	13
Total whole epidemic period included - -	20	61	18	27	31	157	72	234	50	108	139	603	760	266	972	165	397	781	2,581	3,341	22·7	20·7	4·7	18·0	77·3	357	408	392	219	246

* Observations commenced with beginning of 3rd four-weekly division of "epidemic period" (29th week of year). Observations ended with end of 39th week of year.

† Not opened.

The maximum diarrhœal mortality was reached before the stations were opened.

‡ Closed.

TABLE VI.—Showing the Number of Cases of Diarrhœa which were recorded each Week during the Epidemic Season of each Year from 1881 to 1887, at the Stations established by the Corporation of Leicester, specifying Ages, and Proportional and Actual Incidence upon the several Ages—*continued.*

1886.

Weeks ended	Under 1 Year. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	1 and under 5 Years. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total under 5 Years of Age.	5 Years and upwards. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total of Specified Ages.	Proportional Incidence on Age. Under 5, per cent. of All Ages.	Under 1, per cent. of All under 5.	Under 1, per cent. of All Ages.	1 and under 5, per cent. of All Ages.	5 and upwards, per cent. of All Ages.	Actual Incidence on Age per 10,000 Population. Under 1.	1 and under 5.	Under 5.	5 and upwards.	All Ages.
																										[Estimated Population 4,490	15,211	19,701	119,905	139,606]
*28th week of year, July 17	1	8	–	3	7	19	4	19	1	7	23	54	73	6	52	5	12	55	130	203	36·0	26·0	9·4	26·6	64·0	42	36	37	11	15
July 24	8	23	4	9	31	75	27	93	5	30	86	241	316	65	239	39	112	284	739	1,055	30·0	23·7	7·1	22·9	70·0	167	158	160	62	76
„ 31	12	21	2	17	17	69	27	83	9	27	60	206	275	101	230	47	85	192	655	930	29·6	25·1	7·4	22·2	70·4	154	135	140	55	67
August 7	6	12	5	3	5	31	15	50	9	14	33	121	152	51	139	33	63	112	398	550	27·6	20·4	5·6	22·0	72·4	69	80	77	33	39
„ 14	5	13	1	7	12	38	26	64	6	16	37	149	187	86	199	29	69	157	540	727	25·7	20·3	5·2	20·5	74·3	85	98	95	45	52
Total 29th to 32nd week of year	31	69	12	36	65	213	95	290	29	87	216	717	930	303	807	148	329	745	2,332	3,262	28·5	22·9	6·5	22·0	71·5	475	471	472	195	234
August 21	2	10	2	3	4	21	15	51	5	15	27	113	134	76	189	38	62	96	461	595	22·5	15·7	3·5	19·0	77·5	47	74	68	38	43
„ 28	1	6	2	2	5	16	13	21	4	12	37	87	103	52	165	23	46	122	408	511	20·2	15·5	3·1	17·1	79·8	36	57	52	34	37
September 4	3	12	2	2	5	24	11	53	9	9	29	111	135	77	175	39	40	126	457	592	22·8	17·8	4·1	18·7	77·2	53	73	69	38	42
„ 11	2	11	1	3	5	22	12	45	4	7	27	95	117	53	169	28	46	102	398	515	22·7	18·8	4·3	18·4	77·3	49	62	59	33	37
Total 33rd to 36th week of year	8	39	7	10	19	83	51	170	22	43	120	406	489	258	698	128	194	446	1,724	2,213	22·1	17·0	3·8	18·3	77·9	185	266	248	143	159
September 18	1	6	–	–	5	12	9	21	3	2	26	61	73	38	94	11	32	90	265	338	21·6	16·4	3·6	18·0	78·4	27	40	37	22	24
„ 25	1	2	–	–	2	5	3	19	5	–	4	31	36	22	60	11	8	35	136	172	20·9	13·9	2·9	18·0	79·1	11	20	18	11	12
October 2	–	1	–	–	1	2	2	–	2	1	3	8	10	13	5	–	8	20	46	56	17·8	20·0	3·6	14·2	82·2	4	5	5	4	4
„ 9	–	–	–	–	2	2	–	–	–	–	2	2	4	–	–	–	–	17	17	21	19·0	50·0	9·5	9·5	81·0	4	1	2	1	2
Total 37th to 40th week of year	2	9	–	–	10	21	14	40	10	3	35	102	123	73	159	22	48	162	464	587	21·1	16·9	3·6	17·5	78·9	46	66	62	38	42
Total whole epidemic period included	42	125	19	49	101	336	164	519	62	140	394	1,279	1,615	640	1,716	303	583	1,408	4,650	6,265	25·8	20·8	5·4	20·4	74·2	748	839	819	387	450

* Observations commenced with beginning of last week of 2nd four-weekly division of epidemic period (28th week of year). Stations were not opened until just before the highest prevalence was reached. Observations ended with end of epidemic (40th week of year).

TABLE VI.—Showing the Number of Cases of Diarrhœa which were recorded each Week during the Epidemic Season of each Year from 1881 to 1887 at the Stations established by the Corporation of Leicester, specifying Ages, and Proportional and Actual Incidence upon the several Ages—*continued*.

1887.

Weeks ended	Under 1 Year. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	1 and under 5 Years. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total under 5 Years of Age.	5 Years and upwards. Stations. Town Hall.	Wood Boy Street.	Mowbray Street.	Kent Street.	Sanvey Gate.	Total.	Total of Specified Ages.	Proportional Incidence on Age. Under 5, per cent. of All Ages.	Under 1, per cent. of All under 5.	Under 1, per cent. of All Ages.	1 and under 5, per cent. of All Ages.	5 and upwards, per cent. of All Ages.	Actual Incidence on Age per 10,000 Population. Under 1.	1 and under 5.	Under 5.	5 and upwards.	All Ages.
																										[Estimated Population 4,604	15,598	20,202	122,951	143,153]
*24th week of year, June 18	1	–	–	–	–	1	1	1	–	2	3	7	8	2	5	–	2	3	12	20	40·0	12·5	5·0	35·0	60·0	2	4	4	1	1
June 25	–	2	1	2	2	7	–	4	–	1	3	8	15	17	31	1	7	19	75	90	16·7	46·7	7·8	8·9	83·3	15	5	7	6	6
July 2	–	14	2 ys –	4	13	31	9	46	–	4	30	89	120	28	88	13	17	75	221	341	35·2	25·8	10·0	25·2	64·8	67	57	59	18	24
„ 9	5	30	6	5	23	69	26	87	13	24	68	218	287	92	346	34	82	229	783	1,070	26·8	24·0	6·4	20·4	73·2	150	140	142	64	75
„ 16	12	26	5	8	51	102	43	118	24	25	94	304	406	180	523	62	139	411	1,315	1,721	23·6	25·1	5·9	17·7	76·4	222	195	201	107	120
Total 25th to 28th week of year	17	72	12	19	89	209	78	255	37	54	195	619	828	317	988	110	245	734	2,394	3,222	25·7	25·2	6·3	19·4	74·3	454	397	409	195	225
July 23	14	36	5	7	19	81	32	97	15	34	60	238	319	160	519	68	144	326	1,217	1,536	20·8	25·4	5·3	15·5	79·2	176	153	158	99	107
„ 30	17	18	4	8	10	57	31	88	17	24	56	216	273	264	420	69	145	328	1,226	1,499	18·2	20·9	3·8	14·4	81·8	124	138	135	100	105
August 6	3	14	2	3	15	37	20	53	10	25	35	143	180	114	338	51	102	252	857	1,037	17·4	20·6	3·6	13·8	82·6	80	92	89	70	72
„ 13	5	9	3	2	7	26	16	41	18	11	38	124	150	124	315	65	91	206	801	951	15·8	17·3	2·7	13·1	84·2	56	79	74	65	66
Total 29th to 32nd week of year	39	77	14	20	51	201	99	279	60	94	189	721	922	662	1,592	253	482	1,112	4,101	5,023	18·4	21·8	4·0	14·4	81·6	436	462	456	334	350
August 20	1	3	1	2	5	12	12	27	5	9	20	73	85	75	161	19	58	124	437	522	16·3	14·1	2·3	14 0	83·7	26	47	42	36	36
„ 27	2	2	1	1	2	8	5	12	2	11	15	45	53	48	127	18	38	85	316	369	14·4	15·1	2·2	12·2	85·6	17	29	26	26	26
September 3	1	4	1	–	6	12	2	15	1	7	16	41	53	40	135	23	36	91	325	378	14·0	22·6	3·2	10·8	86·0	26	26	26	26	26
„ 10	–	1	–	1	1	3	1	10	1	3	6	21	24	13	68	18	20	31	150	174	13 8	12·5	1·7	12·1	86·2	7	13	12	12	12
Total 33rd to 36th week of year	4	10	3	4	14	35	20	64	9	30	57	180	215	176	491	78	152	331	1,228	1,443	14·9	16·3	2·4	12·5	85·1	76	115	106	100	100
September 17	–	1	–	–	1	2	4	4	1	1	4	14	16	7	34	14	13	24	92	108	14·8	12·5	1·9	12·9	85·2	4	9	8	7	8
„ 24	–	1	–	–	–	1	1	1	–	–	3	5	6	11	27	4	8	12	62	68	8·8	16·7	1·5	7·3	91 2	2	3	3	5	5
October 1	–	–	–	–	–	–	–	–	–	–	3	3	3	–	4	4	–	5	13	16	18·7	–	–	18·7	81·3	–	2	1	1	1
Total 37th to 39th week of year	–	2	–	–	1	3	5	5	1	1	10	22	25	18	65	22	21	41	167	192	13·0	12·0	1·6	11·4	87·0	6	14	12	13	14
Total whole epidemic period included	61	161	29	43	155	449	203	604	107	181	454	1,549	1,998	1,175	3,141	463	902	2,221	7,902	9,900	20·2	22·5	4·5	15·7	79·8	974	909	987	643	690

* Observations commenced in last week of 1st four-weekly division of "epidemic period" (24th week of year) at the commencement of epidemic prevalence.
Observations closed the week before close of "epidemic period" (39th week of year).

TABLE VII.—Dr. Page's 1,497 cases at Redditch; showing for each Four-weekly Period, and for each Diarrhœal Period, in each of Seven Years 1881–87, the Number of Cases which came under Observation.

Year.		Ages. Months. 0–	3–	6–	9–	Years. Under 1.	1–	2–	1 and under 5.	5–	10–	15–	25–	45–	65 and upwards.	Over 5 Years.	Total All Ages.	Diarrhœal Periods. Ages. Under 1 Year.	1–	5–	25–	45–	65 and upwards.	5 Years & upwards.	Total All Ages.
1881																									
Part of Epidemic.	7th period (3 weeks of)	4	1	–	–	5	1	5	6	–	–	–	4	2	–	6	17								
	8th period	2	4	1	–	7	2	9	11	1	–	2	8	5	1	17	35	20	36	9	17	8	2	36	92
	9th „	–	–	2	1	3	3	6	9	1	–	2	3	–	–	6	18								
	10th „	–	3	–	2	5	4	6	10	–	1	2	2	1	1	7	22								
Post-epidemic.	11th „	–	–	–	–	–	2	1	3	–	–	–	1	1	–	2	5								
	12th „	–	–	–	–	–	3	5	8	2	–	2	–	–	–	4	12	2	13	5	2	1	–	8	23 (raised $\frac{3}{5}$rds = 40).
	13th „	1	–	–	1	2	2	–	2	1	–	–	1	–	–	2	6								
Totals		7	8	3	4	22	17	32	49	5	1	8	19	9	2	44	115	22	49	14	19	9	2	44	115
1882.																									
Pre-epidemic.	1st period	–	–	–	–	–	1	1	2	–	1	1	2	1	2	7	9								
	2nd „	1	1	–	2	4	3	3	6	–	–	1	2	–	–	3	13								
	3rd „	–	–	–	–	–	1	2	3	–	–	–	–	2	1	3	6	4	14	4	5	4	3	16	34
	4th „	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–								
	5th „	–	–	–	–	–	1	2	3	–	–	1	1	1	–	3	6								
Epidemic.	6th „	–	–	–	–	–	1	2	3	2	–	–	–	–	–	2	5								
	7th „	1	1	–	2	4	2	1	3	1	–	–	1	–	–	2	9								
	8th „	1	–	1	1	3	2	5	7	3	–	1	2	3	–	9	19	10	28	14	9	9	1	33	71
	9th „	1	–	1	–	2	4	6	10	1	2	2	3	5	–	13	25								
	10th „	–	–	1	–	1	2	3	5	–	–	2	3	1	1	7	13								
Post-epidemic.	11th „	1	–	–	–	1	2	4	6	–	–	1	–	1	–	2	9								
	12th „	–	–	–	–	–	–	–	–	2	–	1	–	–	–	3	3	2	10	5	3	3	–	11	23 (raised $\frac{3}{5}$rds = 40).
	13th „	–	–	–	1	1	2	2	4	–	1	–	3	2	–	6	11								
Totals		5	2	3	6	16	21	31	52	9	4	10	17	16	4	60	128	16	52	23	17	16	4	60	128
1883.																									
Pre-epidemic.	1st period	–	–	–	–	–	1	3	4	–	–	1	1	3	–	5	9								
	2nd „	–	–	1	–	1	2	2	4	1	1	–	3	1	–	6	11								
	3rd „	–	–	–	1	1	–	1	1	–	1	1	–	2	1	5	7	7	18	8	6	9	1	24	49
	4th „	–	–	1	–	1	–	1	1	1	–	–	–	1	–	2	4								
	5th „	–	–	2	2	4	3	5	8	1	–	1	2	2	–	6	18								
Epidemic.	6th „	–	–	–	2	2	4	3	7	1	–	2	2	6	1	12	21								
	7th „	–	1	1	–	2	6	3	9	1	1	3	5	4	2	16	27								
	8th „	1	1	3	1	6	1	4	5	2	2	2	6	4	–	16	27	30	48	18	26	24	7	75	153
	9th „	–	–	4	2	6	8	8	16	1	1	–	7	5	2	16	38								
	10th „	–	6	6	2	14	4	7	11	1	–	1	6	5	2	15	40								
Post-epidemic.	11th „	2	1	3	–	6	3	5	8	2	2	4	3	7	1	19	33								
	12th „	–	–	–	3	3	3	–	3	–	1	3	1	–	–	5	11	9	11	12	5	9	2	28	48 (raised $\frac{3}{5}$rds = 80).
	13th „	–	–	–	–	–	–	–	–	–	–	–	1	2	1	4	4								
Totals		3	9	21	13	46	35	42	77	11	9	18	37	42	10	127	250	46	77	38	37	42	10	127	250

TABLE VII.—Dr. Page's 1,497 cases at Redditch; showing for each Four-weekly Period, and for each Diarrhœal Period, in each of Seven Years 1881–87, the Number of Cases which came under Observation—*continued.*

Year.	Ages.															Diarrhœal Periods.							
	Months.				Years.											Ages.							Total All Ages.
	0–	3–	6–	9–	Under 1.	1–	2–	1 and under 5.	5–	10–	15–	25–	45–	65 and upwards.	Over 5 Years.	Total All Ages.	Under 1 Year.	1–	5–	25–	45–	65 and upwards.	5 Years & upwards.	
1884.																							
Pre-epidemic. 1st period	–	2	1	2	5	1	2	3	1	–	–	1	4	–	6	14								
Pre-epidemic. 2nd „	–	–	1	–	1	1	–	1	–	–	–	3	1	–	4	6								
Pre-epidemic. 3rd „	–	–	–	1	1	–	1	1	–	–	2	–	3	1	6	8	11	6	9	7	13	1	30	47
Pre-epidemic. 4th „	–	–	1	–	1	–	–	–	–	–	2	1	2	–	5	6								
Pre-epidemic. 5th „	–	2	–	1	3	–	1	1	1	1	2	2	3	–	9	13								
Epidemic. 6th „	–	–	–	–	–	2	–	2	–	–	–	3	5	–	8	10								
Epidemic. 7th „	–	–	–	1	1	1	2	3	–	1	2	6	4	–	13	17								
Epidemic. 8th „	–	–	–	2	2	5	5	10	–	1	5	10	5	1	22	34	26	53	44	60	33	4	141	220
Epidemic. 9th „	1	2	8	2	13	19	9	28	6	6	9	27	14	3	65	106								
Epidemic. 10th „	1	2	6	1	10	5	5	10	5	2	7	14	5	–	33	53								
Post-epidemic. 11th „	1	1	–	–	2	–	2	2	1	–	1	–	3	–	5	9								
Post-epidemic. 12th „	–	1	–	–	1	3	1	4	1	–	–	3	3	–	7	12	3	7	5	6	8	1	20	30 (raised ⅘rds = 50).
Post-epidemic. 13th „	–	–	–	–	–	1	–	1	1	–	1	3	2	1	8	9								
Totals	3	10	17	10	40	38	28	66	16	11	31	73	54	6	191	297	40	66	58	73	54	6	191	297
1885.																								
Pre-epidemic. 1st period	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	1								
Pre-epidemic. 2nd „	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1								
Pre-epidemic. 3rd „	–	–	–	–	–	3	2	5	2	–	1	1	–	–	4	9	3	12	6	11	2	3	22	37
Pre-epidemic. 4th „	–	–	–	–	–	–	3	3	–	–	–	4	–	1	5	8								
Pre-epidemic. 5th „	1	1	–	–	2	3	1	4	2	–	1	5	2	2	12	18								
Epidemic. 6th „	1	1	1	–	3	1	1	2	1	–	2	3	4	1	11	16								
Epidemic. 7th „	–	1	1	2	4	3	1	4	–	1	2	2	4	2	11	19								
Epidemic. 8th „	3	3	2	8	16	1	6	7	1	1	4	10	10	6	32	55	32	34	22	33	26	12	93	159
Epidemic. 9th „	2	2	2	2	8	7	10	17	2	2	3	13	3	2	25	50								
Epidemic. 10th „	–	1	–	–	1	3	1	4	–	2	1	5	5	1	14	19								
Post-epidemic. 11th „	–	–	–	–	–	–	–	–	2	–	3	1	2	–	8	8								
Post-epidemic. 12th „	–	–	–	–	–	2	7	9	1	–	1	–	1	1	4	13	–	10	8	3	3	1	15	25 (raised ⅘rds = 42).
Post-epidemic. 13th „	–	–	–	–	–	–	1	1	1	–	–	2	–	–	3	4								
Totals	8	9	6	12	35	23	33	56	12	6	18	47	31	16	130	221	35	56	36	47	31	16	130	221
1886.																								
Pre-epidemic. 1st period	1	1	–	–	2	–	2	2	2	–	4	6	2	–	14	18								
Pre-epidemic. 2nd „	–	–	–	–	–	–	–	–	–	1	4	4	3	3	15	15								
Pre-epidemic. 3rd „	–	–	–	1	1	5	3	8	5	–	4	5	3	–	17	26	3	12	23	24	8	6	61	76
Pre-epidemic. 4th „	–	–	–	–	–	–	2	2	–	–	2	6	–	2	10	12								
Pre-epidemic. 5th „	–	–	–	–	–	–	–	–	–	1	–	3	–	1	5	5								
Epidemic. 6th „	–	–	–	–	–	1	2	3	1	1	1	1	1	–	5	8								
Epidemic. 7th „	1	4	–	–	5	1	2	3	1	2	1	1	5	1	11	19								
Epidemic. 8th „	–	–	1	–	1	3	3	6	–	2	3	4	4	1	14	21	11	36	22	17	21	7	67	114
Epidemic. 9th „	1	–	–	2	3	4	7	11	3	–	1	6	6	2	18	32								
Epidemic. 10th „	1	–	–	1	2	6	7	13	1	1	4	5	5	3	19	34								
Post-epidemic. 11th „	–	1	–	2	3	3	4	7	–	–	2	1	3	–	6	16								
Post-epidemic. 12th „	–	–	–	–	–	–	–	–	1	–	–	2	2	–	5	5	8	13	6	4	5	–	15	36 (raised ⅘rds = 60).
Post-epidemic. 13th „	1	2	2	–	5	2	4	6	2	–	1	1	–	–	4	15								
Totals	5	8	3	6	22	25	36	61	16	8	27	45	34	13	143	226	22	61	51	45	34	13	143	226
1887.																								
Pre-epidemic. 1st period	1	1	1	–	3	1	1	2	–	–	2	2	–	–	4	9								
Pre-epidemic. 2nd „	–	–	–	–	–	1	1	2	–	–	–	1	–	–	1	3								
Pre-epidemic. 3rd „	–	–	–	–	–	1	1	2	–	–	1	4	–	–	5	7	4	9	4	14	2	–	20	33
Pre-epidemic. 4th „	–	1	–	–	1	–	2	2	–	–	–	3	1	–	4	7								
Pre-epidemic. 5th „	–	–	–	–	–	1	–	1	1	–	–	4	1	–	6	7								
Epidemic. 6th „	–	–	–	–	–	–	2	2	–	1	3	6	2	–	12	14								
Epidemic. 7th „	1	–	–	1	2	2	2	4	1	3	2	9	3	–	18	24								
Epidemic. 8th „	1	4	2	1	8	6	6	12	2	4	5	14	5	4	34	54	29	39	44	64	20	8	136	204
Epidemic. 9th „	1	4	3	4	12	5	13	18	–	4	15	31	9	3	62	92								
Epidemic. 10th „	2	1	2	2	7	1	2	3	–	–	4	4	1	1	10	20								
Post-epidemic. 11th „	–	–	–	–	–	–	2	2	1	–	–	2	1	–	4	6								
Post-epidemic. 12th „	–	–	1	–	1	1	–	1	1	1	1	1	4	1	9	11	2	3	4	7	6	1	18	23 (raised ⅘rds = 40).
Post-epidemic. 13th „	–	–	–	1	1	–	–	–	–	–	–	4	1	–	5	6								
Totals	6	11	9	9	35	19	32	51	6	13	33	85	28	9	174	260	35	51	52	85	28	9	174	60

TABLE VIII.—Showing for Dr. Page's Cases at Redditch the number of cases at each Diarrhœal Period (Pre-epidemic, Epidemic, Post-epidemic) in each of 7 years 1881 to 1887 at various ages, together with the Proportional Incidence on age and the Actual Incidence per 1,000 of Population at each age and year, Diarrhœal Period, and for all the years in the aggregate.

	Ages.													Total All Ages.	Proportional Incidence on Age.					Actual Incidence per 1,000 Estimated Population at Various Ages.				
	Months.				Years.																			
	0—	3—	6—	9—	Under 1 Year.	1—	2—	1— under 5.	Under 5 Years.	5—	25—	45—	65 upwards.	5 Years upwards.		Under 5, per cent. of All Ages.	Under 1, per cent. of All under 5 Years.	Under 1, per cent. of All Ages.	1 and under 5, per cent. of All Ages.	5 upwards, per cent. of All Ages.	Under 1.	1 and under 5.	Under 5.	5 and upwards.	All Ages.
Pre-epidemic Period.																									
1881	Wanting.																								
1882	1	1	—	2	4	6	8	14	18	4	5	4	3	16	34	52·9	22·2	11·8	41·1	47·1	12·2	12·4	12·4	1·8	3·3
1883	—	—	4	3	7	6	12	18	25	8	6	9	1	24	49	51·0	28·0	14·3	36·7	49·0	20·8	15·6	16·8	2·7	4·7
1884	—	4	3	4	11	2	4	6	17	9	7	13	1	30	47	36·1	64·7	23·4	12·7	63·9	32·0	5·1	11·1	3·2	4·4
1885	2	1	—	—	3	6	6	12	15	6	11	2	3	22	37	40·0	20·0	8·0	32·0	60·0	8·5	9·9	9·6	2·3	3·4
1886	1	1	—	1	3	5	7	12	15	23	24	8	6	61	76	19·7	20·0	3·9	15·8	80·3	8·3	9·7	9·3	6·3	6·7
1887	1	2	1	—	4	4	5	9	13	4	14	2	—	20	33	39·4	30·8	12·1	27·3	60·6	10·8	7·1	7·9	2·0	2·8
Total 6 years	5	9	8	10	32	29	42	71	103	54	67	38	14	173	276	37·3* or, 44·4	31·1 —	11·6 14·5	25·7 29·9	62·7 55·6	15·3	9·9	11·1	3·1	4·2
Epidemic period.																									
1881†	6	8	3	3	20	10	26	36	56	9	17	8	2	36	92	60·9	35·7	21·7	39·2	59·1	62·4	33·0	39·6	4·2	9·2
1882	3	1	3	3	10	11	17	28	38	14	9	9	1	33	71	53·5	26·3	14·1	39·4	46·5	30·6	24·9	26·2	3·8	6·9
1883	1	8	14	7	30	23	25	48	78	18	26	24	7	75	153	51·0	38·5	19·6	31·4	49·0	89·3	41·6	52·3	8·3	14·6
1884	2	4	14	6	26	32	21	53	79	44	60	33	4	141	220	35·9	32·9	11·8	24·1	64·1	75·6	44·8	51·7	15·3	20·4
1885	6	8	6	12	32	15	19	34	66	22	33	26	12	93	159	41·5	48·5	20·1	21·4	58·5	90·7	28·0	42·1	9·8	14·4
1886	3	4	1	3	11	15	21	36	47	22	17	21	7	67	114	41·2	23·4	9·6	31·6	58·8	30·4	29·0	29·3	6·9	10·1
1887	5	9	7	8	29	14	25	39	68	44	64	20	8	136	204	33·3	42·6	14·2	19·1	66·7	78·4	30·6	41·4	13·7	17·6
Total 7 years	26	42	48	42	158	120	154	274	432	173	226	141	41	581	1,013	42·6	36·6	15·6	27·0	57·4	65·5	33·1	40·4	9·0	13·4
Post-epidemic period.																									
1881	1	—	—	1	2	7	6	13	15	5	2	1	—	8	23	65·2	13·3	8·7	56·5	34·8	6·2	11·9	10·6	0·9	2·3
1882	1	—	—	1	2	4	6	10	12	5	3	3	—	11	23	52·2	16·6	8·7	43·5	47·8	6·1	8·9	8·3	1·3	2·2
1883	2	1	3	3	9	6	5	11	20	12	5	9	2	28	48	41·7	45·0	18·7	23·0	58·3	26·8	9·5	13·4	3·1	4·6
1884	1	2	—	—	3	4	3	7	10	5	6	8	1	20	30	33·3	30·0	10·0	23·3	66·7	8·7	5·9	6·5	2·2	2·8
1885	—	—	—	—	—	2	8	10	10	8	3	3	1	15	25	40·0	—	—	40·0	60·0	—	8·2	6·4	1·6	2·3
1886	1	3	2	2	8	5	8	13	21	6	4	5	—	15	36	58·3	38·1	22·2	36·1	41·7	22·1	10·5	13·1	1·5	3·2
1887	—	—	1	1	2	1	2	3	5	4	7	6	1	18	23	21·7	40·0	8·7	13·0	78·3	5·4	2·4	3·0	1·8	2·0
Total 7 years	6	6	6	8	26	29	38	67	93	45	30	35	5	115	208	44·7	28·0	12·5	32·2	55·3	10·8	8·1	8·7	1·8	2·8
or, raised to the figures which would represent five such 4-weekly periods (for comparison with the above).																									
	10	10	10	13	43	48	63	111	154	75	50	58	8	191	345						17·8	13·4	14·4	3·0	4·6

* Leaving out 1886 which had a disturbing element in an exceptional excess of cases over 5 years of age.
† In this year the observations did not commence until late so that there are only four 4-week periods included instead of five as in the other years.

TABLE IX.—Cases* of Diarrhœa admitted as Out-patients at the Dispensary of the Children's Hospital, Manchester, during 12 years, 1876 to 1887, together with the Deaths that occurred among them.

"Diarrhœa and Dysentery" and "Gastro-Intestinal-Catarrh."

—	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.		Whole Year.		Hosp. Dths.	Total Dths.	Dths. per cent. of Cases.
	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.	Cases.	Dths.			
1876†	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H. 42 O. 194	7 9	—	16	6·8
1877†	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H. 21 O. 283	3 13	—	22	7·2
1878	19	—	19	—	19	—	18	—	20	1	24	—	115	8	145	9	78	4	31	2	13	1	9	—	510	25	3	23	5·5
1879	6	—	11	3	10	1	15	—	12	—	28	1	47	3	93	4	100	8	74	3	28	1	13	1	437	25	2	27	6·2
1880	35	—	77	—	57	—	34	1	56	—	64	2	116	4	377	33	299	43	86	13	35	—	37	—	1,273	96	3	99	7·8
1881	21	1	25	—	36	—	28	1	62	—	49	1	131	5	113	7	108	6	93	2	71	1	31	5	768	29	3	32	4·2
1882	46	—	43	2	67	—	51	—	78	4	76	1	88	7	208	15	102	7	84	7	64	4	41	1	948	48	2	50	5·3
1883	52	2	55	1	51	1	65	2	50	3	62	1	101	5	150	8	125	14	107	6	51	2	33	2	902	47	2	49	5·4
1884	60	2	78	—	59	1	57	—	45	3	59	1	184	10	209	16	211	12	90	10	51	1	35	1	1,138	57	4	61	5·4
1885	49	3	40	—	55	—	56	—	46	—	75	2	112	4	168	9	134	5	81	6	60	—	50	—	926	29	4	33	3·6
1886	56	1	82	2	83	7	72	1	60	3	71	5	176	3	232	11	310	19	157	10	101	4	48	6	1,448	72	6	78	5·4
1887	63	2	43	—	46	2	35	—	30	3	67	1	126	5	216	13	144	7	102	8	75	3	49	—	996	44	7	51	5·1
	407	11	473	8	483	12	431	5	459	17	575	15	1,196	54	1,911	125	1,611	125	905	67	549	17	346	16	9,346	472	—	—	—
																									Cases of 1876–77 - -		540	38			
																									12 Years' Total - - -		9,886	510	36	546	5·5

* Some cases thus admitted were draughted, at the discretion of the medical staff, into the hospital at Pendlebury as in-patients.

† The cases and deaths in these years are not stated in months. The hospital deaths are counted in, because the cases which furnished them are counted into the table.

H. Home-patients, *i.e.*, attended at their homes.

O. Out-patients coming to hospital.

TABLE X.—Cases of "Diarrhœa" treated at the Out-patients' Department of the Children's Hospital, Great Ormond Street, during 12 Years, 1876 to 1887, specifying Ages and Sex.

Years.	Months of Age.										Years of Age.																								Total in Sexes.		Total both Sexes.
	0—		2—		Under 3 months.		3—		6—		Under 1 year.		1—		1½—		2—		3—		4—		1, and under 5 years.		5—		6—		7—		8—		9—		5, and under 10 years.		10—		11—		12 and upwards.		10 years and upwards.				
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		
1876	—	—	10	4	10	4	9	7	17	18	36	29	36	26	28	22	37	17	19	13	7	5	127	83	1	5	3	3	5	5	1	—	3	3	13	16	1	1	—	1	—	—	1	2	177	130	307
1877	1	—	3	8	4	8	10	5	22	21	36	34	38	41	22	27	38	33	35	14	19	15	152	130	15	6	7	8	2	5	2	2	1	4	27	25	2	1	2	1	1	—	5	2	220	191	411
1878	2	1	—	8	2	9	5	9	18	36	25	54	43	55	47	38	31	26	24	31	13	8	158	158	8	3	3	8	1	3	3	3	3	3	18	20	2	3	—	1	1	1	3	5	204	237	441
1879	2	—	1	1	3	1	12	10	16	18	31	29	39	38	32	27	34	16	12	17	22	15	139	113	9	5	7	4	5	2	—	1	1	3	22	15	1	—	1	2	2	—	4	2	196	159	355
1880	2	—	5	5	7	5	9	7	16	18	32	30	39	30	53	35	30	32	27	24	13	13	162	134	4	3	5	3	6	4	5	1	1	—	21	11	1	—	—	3	1	1	2	4	217	179	396
1881	—	—	—	3	—	3	10	5	13	13	23	21	42	26	22	24	32	22	20	19	18	7	134	98	6	5	4	3	—	2	—	2	1	4	11	16	1	—	1	2	—	—	2	2	170	137	307
1882	—	1	4	7	4	8	7	7	19	16	30	31	35	31	40	36	35	29	23	13	13	6	146	115	4	6	7	—	8	—	2	1	—	3	21	10	1	3	1	—	1	1	3	4	200	160	360
1883	2	3	7	—	9	3	12	17	36	19	57	39	62	51	36	22	28	25	19	19	12	8	157	125	8	5	2	5	1	2	1	3	4	2	16	17	4	2	2	1	—	—	6	3	236	184	420
1884	1	—	10	5	11	5	16	7	25	19	52	31	40	28	34	30	29	23	23	9	7	6	133	96	7	8	4	3	1	2	4	1	—	3	16	17	4	2	1	1	—	1	5	4	206	148	354
1885	2	3	11	5	13	8	18	14	30	23	61	45	36	44	61	48	26	29	33	27	16	18	172	166	2	7	3	10	6	5	4	3	1	8	16	33	1	8	4	1	—	—	5	9	254	253	507
1886	—	—	3	6	3	6	11	9	29	28	43	43	44	61	63	51	53	45	37	26	23	12	220	195	10	4	6	6	3	4	2	3	—	1	21	18	5	1	3	2	—	—	8	3	292	259	551
1887	—	1	4	4	4	5	9	5	22	21	35	31	53	47	63	42	38	35	22	27	20	13	196	164	10	10	8	5	2	4	1	1	3	2	24	22	3	4	1	2	2	2	6	8	261	225	486
	12	9	58	56	70	65	128	102	263	250	461	417	507	478	501	402	411	332	294	239	183	126	1,896	1,577	84	67	59	58	40	38	25	21	18	36	226	220	26	25	16	17	8	6	50	48	2,633	2,262	4,895
Both sexes	21		114		135		230		513		878		985		903		743		533		309		3,473		151		117		78		46		54		446		51		33		14		98		4,895		——

TABLE XI.—Population—Census 1881 in Ages (pp. 3 and 8 of Vol. III.) of the Registration Districts surrounding Children's Hospital, Great Ormond Street.

	Under 1 Year.		1—		2—		3—		4—		Under 5 Years.		5—		10—15	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Marylebone -	1,895	1,807	1,561	1,612	1,562	1,552	1,490	1,522	1,466	1,433	7,974	7,926	6,507	6,790	5,813	6,315
Pancras - -	3,361	3,323	3,046	2,961	3,017	2,839	2,805	2,767	2,673	2,599	14,902	14,489	12,023	12,475	10,372	10,934
Islington -	4,293	4,101	3,884	3,775	3,669	3,686	3,478	3,693	3,676	3,358	19,000	18,613	15,748	15,824	13,072	13,645
St. Giles - -	536	567	508	464	462	449	451	468	472	450	2,429	2,398	2,014	2,066	1,886	1,907
Strand - -	347	367	301	320	306	303	302	317	300	289	1,556	1,596	1,330	1,456	1,311	1,348
Holborn - -	2,273	2,194	1,975	1,964	1,921	1,905	1,764	1,825	1,782	1,787	9,715	9,675	7,984	8,071	7,091	7,361
City of London	438	475	409	475	447	381	435	408	435	407	2,164	2,146	2,140	2,032	2,735	2,176
Totals -	13,143	12,834	11,684	11,571	11,384	11,115	10,725	11,000	10,804	10,323	57,740	56,843	47,746	48,714	42,280	43,686
Both Sexes -	25,977		23,255		22,499		21,725		21,127		114,583		96,460		85,966	

Proportion of the above Population of each Sex and at each Age treated in the Out-Patient Department of the Children's Hospital, Great Ormond Street, during 12 Years 1876 to 1887.

Cases 1876-1887.	Under 1 Year.		1—		2—		3—		4—		Under 5 Years.		5—		10—15	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M	F.
Per 10,000 of above Population - -	351	325	858	761	361	299	274	217	169	122	328	277	47	45	12	11
Both Sexes -	338		812		330		245		146		303		46		11	

Causation of "Diarrhœa," by Dr. Ballard.

TABLE XII.—Leicester Cases.—Duration of Fatal Illness in Infants.

1.—In Relation to Age at the Commencement of Illness in 1881 and 1882.

Epidemic of	Ages in Months.																	
	0 –	1 –	2 –	Under 3 mos.	3 –	4 –	5 –	3 and under 6 mos.	6 –	7 –	8 –	6 and under 9 mos.	9 –	10 –	11 –	9 and under 12 mos.	12 mos. and upwards.	Total.
a. Duration under 48 hours.																		
1881 - -	—	1	2	3	2	—	1	3	1	2	—	3	—	1	—	1	3	13
1882 - - -	1	—	—	1	1	—	—	1	1	—	—	1	—	1	—	1	3	7
Totals -	1	1	2	4	3	—	1	4	2	2	—	4	—	2	—	2	6	20
b. Duration 2 and under 4 days.																		
1881 - -	4	1	4	9	1	—	4	5	1	3	1	5	1	1	—	2	2	23
1882 - - -	4	4	4	12	5	2	4	11	3	5	1	9	—	—	—	—	3	35
Totals -	8	5	8	21	6	2	8	16	4	8	2	14	1	1	—	2	5	58
c. Duration 4 and under 7 days.																		
1881 - -	4	7	4	15	1	6	1	8	3	3	3	9	4	1	2	7	3	42
1882 - - -	3	4	8	15	5	7	4	16	2	5	1	8	1	2	2	5	5	49
Totals -	7	11	12	30	6	13	5	24	5	8	4	17	5	3	4	12	8	91
d. Duration 7 and under 14 days.																		
1881 - -	8	4	5	17	6	7	5	18	5	1	4	10	—	1	1	2	3	50
1882 - - -	5	3	7	15	5	7	1	13	6	2	—	8	2	—	—	2	2	40
Totals -	13	7	12	32	11	14	6	31	11	3	4	18	2	1	1	4	5	90
e. Duration 14 and under 21 days.																		
1881 - -	—	1	1	2	—	2	4	6	2	1	—	3	2	—	—	2	—	13
1882 - - -	1	2	3	6	—	1	1	2	3	—	1	4	—	—	2	2	2	16
Totals -	1	3	4	8	—	3	5	8	5	1	1	7	2	—	2	4	2	29
f. Duration 21 days and upwards.																		
1881 - -	1	3	3	7	1	2	1	4	—	3	2	5	3	1	1	5	1	22
1882 - - -	1	1	5	7	4	2	3	9	2	2	2	6	2	2	—	4	4	30
Totals -	2	4	8	14	5	4	4	13	2	5	4	11	5	3	1	9	5	52

Total Number of Infants who died after illness of above Durations.

1881 - -	17	17	19	53	11	17	16	44	12	13	10	35	10	5	4	19	12	163
1882 - - -	15	14	27	56	20	19	13	52	17	14	5	36	5	5	4	14	19	177
Totals -	32	31	46	109	31	36	29	96	29	27	15	71	15	10	8	33	31	340

Causation of "Diarrhœa," by Dr. Ballard.

TABLE XII.—Leicester Cases.—Duration of Fatal Illness in Infants—*continued.*

Numbers per cent. of Infants of different Ages and of all Ages who died after illness of different Duration in 1881 and 1882.

Epidemic of	Ages in Months.																	
	0 –	1 –	2 –	Under 3 mos.	3 –	4 –	5 –	3 and under 6 mos.	6 –	7 –	8 –	6 and under 9 mos.	9 –	10 –	11 –	9 and under 12 mos.	12 mos. and upwards.	Total.
a. Duration under 48 hours.																		
1881 - -	—	5·9	10·5	5·7	18·2	—	6·2	6·8	8·3	15·4	—	8·6	—	20·0	—	5·2	25·0	8·0
1882 - - -	6·6	—	—	1·8	5·0	—	—	1·9	5·9	—	—	2·8	—	20·0	—	7·1	15·7	4·0
Totals -	3·1	3·2	4·3	3·7	9·6	—	3·4	4·2	6·9	7·4	—	5·6	—	20·0	—	6·1	19·3	5·9
b. Duration 2 and under 4 days.																		
1881 - -	23·5	5·9	21·1	17·0	9·1	—	25·0	11·4	8·3	23·1	10·0	14·3	10·0	20·0	—	10·5	16·6	14·1
1882 - - -	26·6	28·6	14·8	21·4	25·0	10·5	30·8	21·2	17·6	35·7	20·0	25·0	—	—	—	—	15·7	19·8
Totals -	25·0	16·1	17·4	19·3	19·4	5·6	27·6	16·7	13·8	29·6	13·3	19·7	6·6	10·0	—	6·1	16·1	17·1
c. Duration 4 and under 7 days.																		
1881 - -	23·5	41·2	21·1	28·3	9·1	35·3	6·2	18·2	25·0	23·1	30·0	25·7	40·0	20·0	50·0	36·8	25·0	25·8
1882 - - -	20·0	28·6	29·6	26·8	25·0	36·8	30·8	30·8	11·7	35·7	20·0	22·2	20·0	40·0	50·0	35·7	26·3	27·7
Totals -	21·9	35·5	26·1	27·5	19·4	36·1	17·2	25·0	17·2	29·6	26·7	23·9	33·3	30·0	50·0	36·4	25·8	26·8
d. Duration 7 and under 14 days.																		
1881 - -	47·1	23·5	26·3	32·1	54·5	41·2	31·2	40·9	41·7	7·7	40·0	28·5	—	20·0	25·0	10·5	25·0	30·7
1882 - -	33·3	21·4	25·9	26·8	25·0	36·8	7·7	25·6	35·3	14·2	—	22·2	40·0	—	—	14·2	10·5	22·6
Totals -	40·6	22·6	26·1	29·4	35·5	38·9	20·7	32·3	37·9	11·1	26·7	25·4	13·3	10·0	12·5	12·1	16·1	26·5
e. Duration 14 and under 21 days.																		
1881 - -	—	5·9	5·3	3·8	—	11·8	25·0	13·6	16·6	7·7	—	8·6	20·0	—	—	10·5	—	8·0
1882 - - -	6·6	14·3	11·1	10·7	—	5·2	7·7	3·8	17·6	—	20·0	11·1	—	—	50·0	14·2	10·5	9·0
Totals -	3·1	9·7	8·7	7·3	—	8·3	17·2	8·3	17·2	3·7	6·6	9·9	13·3	—	25·0	12·1	6·5	8·5
f. Duration 21 days and upwards.																		
1881 - -	5·9	17·6	15·8	13·2	9·1	11·8	6·2	9·1	—	23·1	20·0	14·3	30·0	20	25·0	26·3	8·3	13·5
1882 - - -	6·6	7·1	18·5	12·5	20·0	10·5	23·1	17·3	11·7	14·2	40·0	16·7	40·0	40	—	23·6	21·1	16·9
Totals -	6·2	12·9	17·4	12·8	16·1	11·1	13·8	13·5	6·9	18·5	26·7	15·5	33·3	30	12·5	27·3	16·1	15·0

Causation of "Diarrhœa," by Dr. Ballard.

TABLE XIII.—Leicester Cases.—Duration of Fatal Illness in Infants.

2. In relation to period of Epidemic Season at which Diarrhœal Illness commenced.

Number of Cases whose Fatal Illness commenced in Certain Weeks.*

1881.

Week ended	Duration of Illness: Under 48 hours.	2 and under 4 days.	4 and under 7 days.	7 and under 14 days.	14 and under 21 days.	21 days and upwards.	Total.
July 9 - (27th week of year.)	—	—	—	5	1	2	8‖
„ 16 -	1	3	5	5	1	6	21
„ 23 -	4	8	9	14	—	5	40
„ 30 -	1	4	8	6	5	1	25
Aug. 6 -	2	1	10	13	3	4	33
„ 13 -	1	3	3	6	2	—	15
„ 20 -	4	3	2	—	—	—	9
„ 27 -	—	—	2	1	—	—	3
Sept. 3 -	—	—	—	—	—	—	—
„ 10 -	—	1	3	—	—	—	4
Totals -	13	23	42	50	12†	18‡	158

‖ Only 1 infant, aged between 3 and 6 months, died this week, but duration of illness is unknown, as date of commencement of illness is unknown.

† 5 of these had durations of 2 weeks (or 14 days).
1 „ „ 15 days.
1 „ „ 16 „
1 „ „ 18 „
1 „ „ 19 „
1 „ „ 20 „
2 „ „ "2 to 3 weeks."

‡ 2 of these had durations of 2 months.
9 „ „ 1 month (or about 4 weeks).
7 „ „ 3 weeks (21 to 24 days).

1882.

Week ended	Duration of Illness: Under 48 hours.	2 and under 4 days.	4 and under 7 days.	7 and under 14 days.	14 and under 21 days.	21 days and upwards.	Total.
July 1 - (26th week of year.)	—	—	3	1	1	3	8‖
„ 8 -	—	4	4	11	—	6	25
„ 15 -	—	2	5	2	1	6	16
„ 22 -	—	3	7	6	8	3	27
„ 29 -	—	3	6	2	3	2	16
Aug. 5 -	1	4	5	6	1	2	19
„ 12 -	—	7	6	3	—	2	18
„ 19 -	1	2	4	5	—	1	13
„ 26 -	2	1	7	2	—	1	13
Sept. 2 -	1	3	—	1	—	1	6
„ 9 -	2	4	—	1	2	—	9
„ 17 -	—	2	2	—	—	—	4
Totals -	7	35	49	40	16†	27‡	174

‖ Only 2 infants aged one under 1 month, the other between 3 and 6 months, died this week, but duration of their illness is unknown, as date of commencing illness is unknown.

† 5 of these had durations of 2 weeks (or 14 days).
2 „ „ 15 days.
1 „ „ 16 „
2 „ „ 17 „
2 „ „ 18 „
1 „ „ 19 „
1 „ „ 20 „
2 „ „ "2 to 3 weeks."

‡ 1 of these had durations of 2 months.
1 „ „ 6 weeks.
7 „ „ "4 to 5 weeks."
13 „ „ "1 month" (or about 4 weeks).
5 „ „ 3 weeks.

* To be read thus—Of 8 infants whose *fatal* illness commenced in week ended July 9, 1881, 5 were ill for 7 to 13 days before death, &c., &c.

Per-centage of Fatal Cases having had different Duration of Illness of those commencing each Week.**

1881.

Week ended	Duration of Illness: Under 48 hours.	2 and under 4 days.	4 and under 7 days.	7 and under 14 days.	14 and under 21 days.	21 days and upwards.
July 9 - -	—	—	—	62·5	12·5	25·0
„ 16 - -	4·8	14·3	23·8	23·8	4·8	28·6
„ 23 - -	10·0	20·0	22·5	35·0	—	12·5
„ 30 - -	4·0	16·0	32·0	24·0	20·0	4·0
Aug. 6 - -	6·1	3·0	30·3	39·3	9·1	12·1
„ 13 - -	6·7	20·0	20·0	40·0	13·3	—
„ 20 - -	44·4	33·3	22·2	—	—	—
„ 27 - -	—	—	66·6	33·3	—	—
Sept. 3 - -	—	—	—	—	—	—
„ 10 - -	—	25·0	75·0	—	—	—
Whole 10 weeks -	8·2	14·6	26·6	31·6	7·6	11·4

1882.

Week ended	Duration of Illness: Under 48 hours.	2 and under 4 days.	4 and under 7 days.	7 and under 14 days.	14 and under 21 days.	21 days and upwards.
July 1 - -	—	—	37·5	12·5	1·25	37·5
„ 8 - -	—	16·0	16·0	44·4	—	24·0
„ 15 - -	—	12·5	31·2	12·5	6·2	37·5
„ 22 - -	—	11·1	25·9	22·2	29·6	11·1
„ 29 - -	—	18·7	37·5	12·5	18·7	12·5
Aug. 5 - -	5·3	21·1	26·3	31·6	5·3	10·5
„ 12 - -	—	38·9	33·3	16·7	—	11·1
„ 19 - -	7·7	15·4	30·8	38·5	—	7·7
„ 26 - -	15·4	7·7	53·8	15·4	—	7·7
Sept. 2 - -	16·6	50·0	—	16·6	—	16·6
„ 9 - -	22·2	44·4	—	11·1	22·2	—
„ 17 - -	—	50·0	50·0	—	—	—
Whole 12 weeks	4·0	20·1	28·2	23·0	9·2	15·5

** To be read thus—Of those fatal cases whose illness commenced on week ended July 9, 1881, 62·5 per cent. were ill for from 7 to 13 days before they died, &c., &c.

Causation of "Diarrhœa," by Dr. Ballard.

TABLE XIV.—Leicester Cases.

Duration of Fatal Illness and Ages in Months of Age at Commencement of Illness.

Weeks of Epidemic.	Under 48 Hours. Ages.					2 and under 4 Days. Ages.					4 and under 7 Days. Ages.					Under 7 Days. Ages.					7 and under 14 Days. Ages.					14 and under 21 Days. Ages.					21 Days and upwards. Ages.				
	0–	3–	6–	9–	12+	0–	3–	6–	9–	12+	0–	3–	6–	9–	12+	0–	3–	6–	9–	12+	0–	3–	6–	9–	12+	0–	3–	6–	9–	12+	0–	3–	6–	9–	12+
1881.																																		
1st	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	3	1	–	–	–	1	–	–	–	1	–	–	1	–
2nd	–	–	1	–	–	–	3	–	–	–	2	1	–	2	–	2	4	1	2	–	1	2	1	–	1	–	–	–	1	–	1	3	–	–	1
3rd	1	1	1	–	1	3	1	2	2	–	3	1	4	1	–	7	3	7	3	1	6	4	5	–	–	–	–	–	–	–	2	–	2	1	–
4th	–	1	–	–	–	2	–	1	–	1	4	1	1	2	–	6	2	2	2	1	1	2	1	2	–	2	2	–	1	–	1	–	–	–	–
5th	–	–	1	–	1	–	–	1	–	–	2	3	3	1	1	2	3	5	1	2	2	7	2	–	2	–	2	1	–	–	1	–	2	1	–
6th	–	–	–	1	–	1	1	–	–	1	2	–	–	1	–	3	1	–	2	1	5	–	1	–	–	–	–	2	–	–	–	–	–	–	–
7th	2	1	–	–	1	2	–	1	–	–	2	–	–	–	–	6	1	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
8th	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	1	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9th	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
10th	–	–	–	–	–	1	–	–	–	–	–	2	–	–	1	1	2	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Totals	3	3	3	1	3	9	5	5	2	2	15	8	9	7	3	27	16	17	10	8	17	18	11	2	3	2	5	3	2	–	6	3	4	3	1
1882.																																		
1st	–	–	–	–	–	–	–	–	–	–	–	2	–	1	–	–	2	–	1	–	–	–	–	–	1	–	1	–	–	–	1	1	–	1	–
2nd	–	–	–	–	–	–	2	2	–	–	3	1	–	–	–	3	3	2	–	–	7	1	2	1	–	–	–	–	–	–	1	3	–	1	1
3rd	–	–	–	–	–	–	1	1	–	–	1	4	–	–	–	1	5	1	–	–	–	1	1	–	–	–	–	1	–	–	–	3	1	–	2
4th	–	–	–	–	–	–	–	3	–	–	1	1	3	1	1	1	1	6	1	1	2	3	1	–	–	5	1	–	1	1	1	1	1	–	–
5th	–	–	–	–	–	3	–	–	–	–	3	2	–	–	1	6	2	–	–	1	–	1	1	–	–	–	–	3	–	–	1	–	1	–	–
6th	–	1	–	–	–	1	1	1	–	1	3	–	–	–	2	4	2	1	–	3	2	2	1	1	–	–	–	–	–	1	–	1	1	–	–
7th	–	–	–	–	–	3	3	–	–	1	–	3	–	2	1	3	6	–	2	2	2	1	–	–	–	–	–	–	–	–	–	–	1	1	–
8th	–	–	–	–	1	–	1	1	–	–	–	2	1	1	–	–	3	2	1	1	1	2	1	–	1	–	–	–	–	–	–	–	–	1	–
9th	–	–	–	1	1	–	–	–	–	1	3	–	4	–	–	3	–	4	1	2	–	1	1	–	–	–	–	–	–	–	–	–	–	–	1
10th	–	–	1	–	–	3	–	–	–	–	–	–	–	–	–	3	–	1	–	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–
11th	1	–	–	–	1	1	3	–	–	–	–	–	–	–	–	2	3	–	–	1	–	1	–	–	–	1	–	–	1	–	–	–	–	–	–
12th	–	–	–	–	–	1	–	1	–	–	1	1	–	–	–	2	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Totals	1	1	1	1	3	12	11	9	–	3	15	16	8	5	5	28	28	18	6	11	15	13	8	2	2	6	2	4	2	2	5	9	5	4	4

TABLE XV.—Showing in detail the Ages of the Fatal Cases enumerated in Table XIV.

Duration.

1881.

Week of Epidemic in which Illness commenced.	Under 48 Hours. Ages.	2 and under 4 Days. Ages.	4 and under 7 Days. Ages.	7 and under 14 Days. Ages.	14 and under 21 Days. Ages.	21 Days and upwards. Ages.
1st - -	—	—	—	4 mos., 4 mos., 2 mos., 6 mos., 3 mos.	5 mos.	9 mos., 1 mo.
2nd -	6 mos.	5 mos., 5 mos., 5 mos.	4 mos., 1 mo., 11 mos., 1 mo., 9 mos.	12 mos., 5 mos., under 1 mo., 4 mos., 7 mos.	9 mos.	2 mos., 5 mos., 13 mos., 4 mos., 10 mos., 3 mos.
3rd - -	2 mos., 7 mos., 3 mos., 14 mos.	2 mos., 10 mos., 5 mos., 7 mos., und. 1 mo., 8 mos, 9 mos., und. 1 mo.	6 mos., 7 mos., 1 mo., 4 mos., 1 mo., 6 mos., und. 1 mo., 8 mos., 10 mos.	Und. 1 mo., und. 1 mo., 6 mos., und. 1 mo., 1 mo., 3 mos., 4 mos, 6 mos., 6 mos., 8 mos., 3 mos., 1 mo., 2 mos., 5 mos.	—	2 mos., 9 mos., 1 mo., 7 mos., 7 mos.
4th - -	3 mos.	6 mos., 17 mos., 1 mo., 2 mos.	1 mo., 6 mos., under 1 mo., 9 mos., 2 mos., 2 mos., 11 mos., 4 mos.	8 mos., 3 mos., 11 mos., 5 mos., 10 mos., und. 1 mo.	2 mos., 9 mos., 5 mos., 1 mo., 5 mos.	1 mo.
5th -	14 mos., 7 mos.	7 mos.	1 mo., 4 mos., 8 mos., 4 mos., 7 mos., 9 mos., 3 mos., 12 mos., 8 mos., 2 mos.	5 mos., 3 mos., 4 mos., 12 mos., 4 mos., 4 mos., 6 mos., 1 mo., 8 mos., 5 mos., 16 mos., 2 mos., 3 mos.	7 mos., 5 mos., 4 mos.	7 mos., 2 mos., 8 mos., 9 mos.
6th - -	10 mos.	21 mos., 3 mos., 2 mos.	2 mos., 1 mo., 9 mos.	8 mos., und. 1 mo., und. 1 mo., 2 mos., und. 1 mo., 2 mos.	6 mos., 6 mos.	—
7th - -	16 mos., 1 mo., 5 mos., 2 mos.	7 mos., und. 1 mo., und. 1 mo.	Und. 1 mo., und. 1 mo.	—	—	—
8th -	—	—	19 mos., 7 mos.	1 mo.	—	—
9th - -	—	—	—	—	—	—
10th -	—	2 mos.	4 mos, 5 mos., 20 mos.	—	—	—

Causation of "Diarrhœa," by Dr. Ballard.

TABLE XV.—*continued.*

DURATION.

1882.

Week of Epidemic in which Illness commenced.	Under 48 Hours.	2 and under 4 Days.	4 and under 7 Days.	7 and under 14 Days.	14 and under 21 Days.	21 Days and upwards.
1st - -	—	4 mos., 11 mos., 3 mos.	12 mos.	4 mos.	—	2 mos., 3 mos., 10 mos.
2nd -	—	3 mos., 3 mos., 7 mos., 7 mos.	4 mos., und. 1 mo., 2 mos , 1 mo.	2 mos., und. 1 mo., 4 mos., 2 mos., 9 mos., 1 mo., und. 1 mo., 6 mos., 1 mo., 7 mos., und. 1 mo.	—	17 mos., 10 mos., 3 mos., 3 mos., 5 mos., 2 mos.
3rd - -	—	4 mos., 6 mos.	5 mos., 5 mos., 3 mos., 5 mos., 1 mo.	4 mos., 7 mos.	6 mos.	17 mos., 4 mos., 4 mos., 3 mos., 6 mos., 12 mos.
4th -	—	7 mos., 6 mos., 7 mos.	6 mos., 8 mos., 9 mos., 7 mos., 3 mos., 2 mos., 3 years.	6 mos., 2 mos., 4 mos., 3 mos., 2 mos., 4 mos.	2 mos., 19 mos., 5 mos., und. 1 mo., 1 mo., 2 mos., 1 mo., 11 mos.	2 mos., 5 mos., 8 mos.
5th - -	—	1 mo., und. 1 mo., 2 mos.	4 mos., 2 mos., und. 1 mo., 15 mos., 1 mo., 4 mos.	4 mos., 6 mos.	8 mos., 6 mos., 6 mos.	1 mo., 7 mos.
6th -	3 mos.	8 mos., 12 mos., 2 mos., 5 mos.	2 years, 2 mos., 13 mos., 1 mo., 2 mos.	9 mos., 4 mos., und. 1 mo., 6 mos., 3 mos., 2 mos.	14 mos.	6 mos., 5 mos.
7th - -	—	1 mo., 1 mo., 12 mos., 3 mos., 3 mos., 4 mos., und. 1 mo.	3 mos., 14 mos., 4 mos., 4 mos., 10 mos., 11 mos.	1 mo., 4 mos., 2 mos.	—	9 mos., 8 mos.
8th -	15 mos.	5 mos., 6 mos.	10 mos., 7 mos., 5 mos., 4 mos.	3 mos., 3 mos., 6 mos., und. 1 mo., 16 mos.	—	9 mos.
9th - -	16 mos., 10 mos.	2 years.	7 mos., 7 mos., 2 mos., und. 1 mo., 2 mos., 7 mos., 6 mos.	6 mos., 5 mos.	—	16 mos.
10th -	6 mos.	2 mos., 2 mos., 1 mo.	—	2 mos.	—	Under 1 mo.
11th - -	3 years, und. 1 mo.	3 mos., 5 mos., under 1 mo., 5 mos.	—	3 mos.	11 mos., 2 mos.	—
12th -	—	Und. 1 mo., 7 mos.	2 mos., 3 mos.	—	—	—

Causation of "Diarrhœa," by Dr. Ballard.

TABLE XVI.

A Provisional Table showing for Counties of England and Wales, grouped according to Density of Population, the Annual Death Rate of Infants under five years of age from Diarrhœa, from the Four Principal "Zymotic" Diseases of Children and from all other Causes during ten years, 1871–80.

[Constructed from the materials furnished by the Census of 1881, and the Supplement to the 45th Report of the Registrar-General.]

Counties.

—	Acres to one Person, 1871–80.	Containing Urban Districts with Population of 10,000 and upwards in 1881.									In 1881, Rate per 1,000 of Female Population employed in Factories, &c.†	Annual Death-rates per 100,000 of Infants under five years of age.		
		Population, 10,000 and under 30,000.			Population, 30,000 and under 40,000.			Population, 40,000 and upwards.						
		No. of Urban Districts.	Per cent. of Population of County.	Acres to one Person, 1881.	No. of Urban Districts.	Per cent. of Population of County.	Acres to one Person, 1881.	No. of Urban Districts.	Per cent. of Population of County.	Acres to one Person, 1881.		Diarrhœa rate.	Zymotic rate (four principal Zymotics).	Rate for other Causes than Diarrhœa and Zymotics.
1. *Four acres and upwards to one Person.*														
Westmoreland	7·77	1	21	0·19	—	—	—	—	—	—	53	130	506	3,262
Rutland	4·63	—	—	—	—	—	—	—	—	—	36	219	594	3,444
North Wales	4·43	3	14	0·72	—	—	—	—	—	—	37	124	736	4,009
North Riding, York	4·42	2	7	0·11	1	9	0·07	1	17	0·04	37	450	737	4,322
Hereford	4·35	1	16	0·24	—	—	—	—	—	—	36	224	473	3,207
Cumberland	4·12	3	17	0·09	1	14	0·04	—	—	—	60	411	1,006	4,270
Totals and Means‡		10	12·5		2	2·8		1	2·8		43	259	675	3,752
2. *Three and under four Acres to one Person.*														
Lincoln	3·89	5	17	0·34	1	8	0·10	—	—	—	33	417	620	3,753
Huntingdon	3·68	—	—	—	—	—	—	—	—	—	57	384	537	3,524
Shropshire	3·50	1	9	0·13	—	—	—	—	—	—	34	327	588	3,589
Dorset	3·27	3	19	0·24	—	—	—	—	—	—	83	170	519	3,318
South Wales	3·25	6	18	0·32	1	8	0·44	4	57	0·21	48	225	1,023	4,563
Wilts	3·22	3	18	0·09	—	—	—	—	—	—	59	230	552	3,287
Northumberland	3·14	2	7	0·60	—	—	—	2	43	0·03	37	589	1,111	5,056
Norfolk	3·01	1	4	0·17	—	—	—	2	30	0·08	72	463	645	4,002
Cambridge	3·00	—	—	—	1	18	0·09	—	—	—	39	425	583	3,839
Total and Means‡		21	10·2		3	3·8		8	14·4		51	358	686	3,881
3. *Two and under three Acres to one Person.*														
Oxford	2·73	1	6	0·38	1	21	0·06	—	—	—	64	320	514	3,851
Devon	2·71	4	10	0·33	1	5	0·04	2	20	0·02	77	362	927	3,777
Buckingham	2·64	1	6	0·03	—	—	—	—	—	—	122	350	653	3,774
Suffolk	2·64	2	10	0·14	—	—	—	1	14	0·16	66	354	533	3,548
Cornwall	2·57	3	11	0·23	—	—	—	—	—	—	63	321	873	4,507
Berks	2·42	2	9	0·11	—	—	—	1	16	0·05	42	354	576	3,441
Northampton	2·41	3	17	0·19	—	—	—	1	18	0·02	116	517	741	4,252
Hertford	2·22	2	10	0·07	—	—	—	—	—	—	112	416	616	3,369
Somerset	2·19	3	8	0·11	1†	8	0·02	1	10	0·06	94	308	714	3,557
East Riding, York	2·08	1	3	0·21	—	—	—	2	56	0·02	44	867	781	4,678
Sussex	2·07	3	11	0·13	—	—	—	2	30	0·03	36	361	476	3,249
Bedford	2·01	2	28	0·10	—	—	—	—	—	—	282	537	741	4,260
Total and Means‡		27	10·7		3	2·8		10	13·7		94	422	678	3,855
4. *One and under two Acres to one Person.*														
Hants	1·90	4	12	0·13	—	—	—	2	32	0·03	46	366	648	3,441
Monmouth	1·88	2	39	0·48	1	29	0·07	—	—	—	42	295	1,061	5,858
Essex	1·82	3	14	0·23	—	—	—	1	23	0·04	57	421	695	3,601
Leicester	1·78	1	4	0·39	—	—	—	1	37	0·02	169	963	932	4,973
Derby	1·57	2	8	0·10	—	—	—	1	21	0·04	110	386	820	4,531
Nottingham	1·52	5	14	0·52	—	—	—	1	42	0·05	158	622	902	5,052
Kent (Extra-Metropolitan)	1·45	14	39	0·15	1	4	0·04	—	—	—	39	410	615	3,602
Gloucester	1·38	2	7	0·11	1	7	0·04	2	40	0·03	89	397	796	4,191
Worcester	1·21	4	22	0·05	1	8	0·03	—	—	—	105	534	830	4,082
Cheshire	1·11	8	20	0·15	2	12	0·08	2	25	0·04	123	527	1,006	4,518
Surrey (Extra-Metropolitan)	1·10	7	26	0·13	—	—	—	1	17	0·12	33	357	609	3,278
Total and Means‡	—	52	18·6		6	5·4		11	21·5		88	479	810	4,284
5. *Less than one Acre to one Person.*														
Durham	0·94	9	16	0·17	1	4	0·11	4	32	0·03	32	660	1,313	5,874
Warwick	0·90	2	4	0·20	—	—	—	3	68	0·02	132	835	1,154	4,900
West Riding, York	0·88	17	14	0·16	1	1	0·05	6	44	0·07	164	687	1,168	5,636
Stafford	0·81	20	36	0·16	2	7	0·09	5	28	0·07	93	664	1,143	5,367
Middlesex (Extra-Metropolitan)	0·55	13	59	0·25	—	—	—	1	12	0·09	34	513	727	3,592
Lancaster	0·41	45	21	0·17	5	5	0·09	14	53	0·03	198	884	1,455	5,883
Total and Means‡	—	106	25·0		9	2·8		33	39·5		109	707	1,125	5,208
All England	1·53											563	1,024	4,725

* This information is not given separately in the Census, but I have constructed this column by selecting from the occupations given in the Census those which are, in my experience, wholly, or for the most part, carried on in factories, workshops, &c. away from the females' homes. I have introduced this column partly in order to avoid some future repetition.

† Somersetshire portion of Bristol, a town over 40,000 population.

‡ These means are only, of course, distantly approximate, but are sufficient for my present purpose.

[To follow p. 11.]

Chart of the Annual Mortality from Diarrhœa and Dysentery per 10,000 Population in England and Wales, from 1838 to 1887, with the Mean Temperature (Greenwich) of each year and quarter from 1849 to 1887.

	1838	1839	1840	1841	1842	1843	1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855	1856	1857	1858	1859	1860	1861	1862	1863	1864	1865	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887
Mean Temperature : Whole Year.		50·1	49·3	49·2	50·6	47·7	48·9	47·1	49·0	51·0	49·2	50·7	47·0	49·4	49·5	50·3	48·5	50·3	49·8	48·6	51·5	49·5	48·7	48·7	50·7	48·9	49·3	49·2	50·1	49·4	49·6	46·2	49·4	48·7	49·7	49·4	50·7	48·6	48·7	47·8
Departure from Average of 39 years.		+0·7	0·0	−0·1	+1·3	−1·6	−0·4	−2·2	−0·3	+1·7	−0·1	+1·4	−2·3	+0·1	+0·2	+1·0	−0·8	+1·0	+0·5	−0·7	+2·2	+0·2	−0·6	−0·6	+1·4	−0·4	0·0	−0·1	+0·8	+0·1	+0·3	−3·1	+0·1	−0·6	+0·4	+0·1	+1·4	−0·7	−0·6	−1·5
1st Quarter.		41·9	39·4	41·3	41·4	38·1	40·8	34·1	40·0	39·2	37·8	43·3	38·8	39·9	41·0	42·6	37·9	36·5	41·2	38·9	41·4	41·3	38·0	40·2	43·6	39·4	41·4	39·5	39·5	42·3	41·5	37·1	39·8	37·3	42·3	40·0	43·4	40·3	36·5	37·3
2nd Quarter.		51·7	53·3	51·5	51·2	51·8	51·7	50·5	52·3	53·8	54·3	53·7	50·5	51·8	53·3	53·1	53·1	56·2	53·0	53·5	55·8	52·0	54·4	51·5	52·8	51·8	52·8	53·4	51·7	51·9	54·6	49·5	52·4	52·9	53·0	53·0	52·5	52·4	52·5	51·6
3rd Quarter.		61·0	59·6	59·3	61·3	58·5	59·8	60·4	59·3	63·3	61·0	62·8	56·2	60·4	58·8	58·8	59·4	62·5	58·9	59·7	63·9	61·4	60·7	61·3	61·1	60·3	60·9	60·7	61·8	58·5	60·8	58·1	61·4	60·0	58·1	59·5	62·7	59·1	61·2	61·0
4th Quarter.		44·6	44·7	43·7	48·1	42·3	43·7	42·7	44·2	47·9	43·8	43·3	42·6	45·5	45·0	46·8	43·7	46·0	46·2	42·5	45·1	43·3	41·6	41·8	45·3	44·2	42·3	43·1	47·0	45·0	41·6	39·9	44·0	44·6	44·7	44·9	44·1	42·8	44·6	41·3

Deaths per 10,000 Popn.

Mean Temp. 3rd Quarter

Deaths from Diarrhœa and Dysentery.

Mean Temp.r (Fahr.)

145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20

63° 62° 61° 60° 59° 58° 57° 56°

CHOLERA YEAR

CHOLERA YEAR

CHOLERA YEAR

1838 1839 1840 1841 1842 1843 1844 1845 1846 1847 1848 1849 1850 1851 1852 1853 1854 1855 1856 1857 1858 1859 1860 1861 1862 1863 1864 1865 1866 1867 1868 1869 1870 1871 1872 1873 1874 1875 1876 1877 1878 1879 1880 1881 1882 1883 1884 1885 1886 1887

Dangerfield Lith. 22 Bedford St. Covent Garden

CHART II.

[To follow p. 77.]

Chart of the Annual Mortality from Diarrhœa and Dysentery per 10,000 Population in London, from 1838 to 1887. with the Mean Temperature (Greenwich) of each year and quarter from 1849 to 1887.

	1838	1839	1840	1841	1842	1843	1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855	1856	1857	1858	1859	1860	1861	1862	1863	1864	1865	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887
Mean Temperature : Whole Year.												50·0	49·8	49·2	50·6	47·7	48·9	47·1	49·0	51·0	49·2	50·7	47·0	49·4	49·5	50·3	48·5	50·3	49·8	48·6	51·5	49·5	48·7	48·7	50·7	48·9	49·3	49·2	50·1	49·4	49·6	46·2	49·4	48·7	49·7	49·4	50·7	48·6	48·7	47·8
Departure from Average of 39 years.												+0·7	0·0	−0·1	+1·3	−1·6	−0·4	−2·2	−0·3	+1·7	−0·1	+1·4	−2·3	+0·1	+0·2	+1·0	−0·8	+1·0	+0·5	−0·7	+2·2	+0·2	−0·6	−0·6	+1·4	−0·4	0·0	−0·1	+0·8	+0·1	+0·3	−3·1	+0·1	−0·6	+0·4	+0·1	+1·4	−0·7	−0·6	−1·5
1st Quarter.												41·9	39·4	41·3	41·4	38·1	40·8	34·1	40·0	39·2	37·8	43·3	38·8	39·9	41·0	42·6	37·9	36·5	41·2	38·9	41·4	41·3	38·0	40·2	43·6	39·4	41·4	39·5	39·5	42·3	41·5	37·1	39·8	37·3	42·3	40·0	43·4	40·8	36·5	37·3
2nd Quarter.												51·7	53·5	51·5	51·2	51·8	51·7	50·5	52·3	53·8	54·3	53·7	50·5	51·8	53·3	53·1	53·1	56·2	53·0	53·5	55·8	52·0	54·4	51·5	52·8	51·8	52·8	53·4	51·7	51·9	54·6	49·5	52·4	52·9	53·0	53·0	52·5	52·4	52·5	51·6
3rd Quarter.												61·0	59·6	59·8	61·8	58·5	59·8	60·4	59·9	63·3	61·0	62·8	56·2	60·4	58·8	58·8	59·4	62·5	58·9	59·7	63 9	61·4	60·7	61·3	61·1	60·3	60·9	60·7	61·8	58·5	60·8	58·1	61·4	60·0	58·1	59·5	62·7	59·1	61·2	61·0
4th Quarter.												44·8	44·7	43·7	48·1	42·3	43·7	42·7	44·2	47·9	43·8	43·3	42·6	45·5	45·0	46·8	43·7	46·0	46·2	42·5	45·1	43·3	41·6	41·8	45·3	44·2	42·3	43·1	47·0	45·0	41·6	39·9	44·0	44·6	44·7	44·9	44·1	42·8	44·6	41·3

Deaths per 10,000 Popn.

Mean Temp. (Fahr.)

Mean Temp. 3rd Quarter

Deaths from Diarrhœa and Dysentery

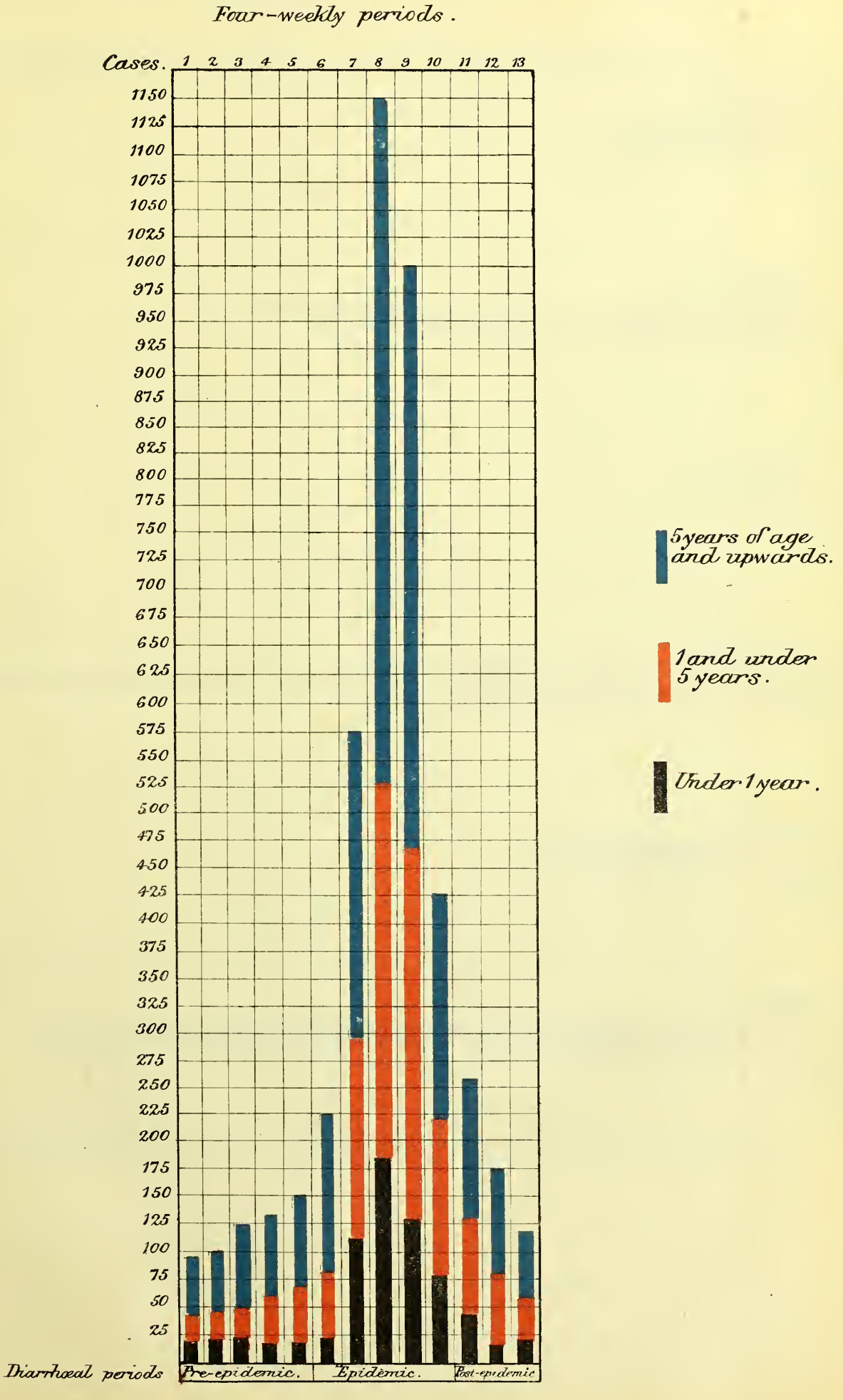
CHOLERA YEAR

CHOLERA YEAR

CHOLERA YEAR

DANGERFIELD LITH 22, BEDFORD ST COVENT GARDEN. 5 88. 16271.

CHART III. *Showing the distribution into 13 4-weekly periods of 4516 cases of Diarrhœa newly occurring in the Poorlaw Medical Practice of Islington during the aggregate of 6 years, 1857 to 1862, distinguishing certain ages.*



DANCERFIELD LITH 22, BEDFORD ST COVENT GARDEN. 16007.3/88.

CHART IV. *Showing for the Poor-law Medical Practice of Islington during each of six years 1857–1862 the number of New Cases of Diarrhœa in each 4-weekly period at ages under 1 year, 1 and under 5 years, and 5 years & upwards. and the proportion of the Cases at each of the above ages to the whole number that occurred.*

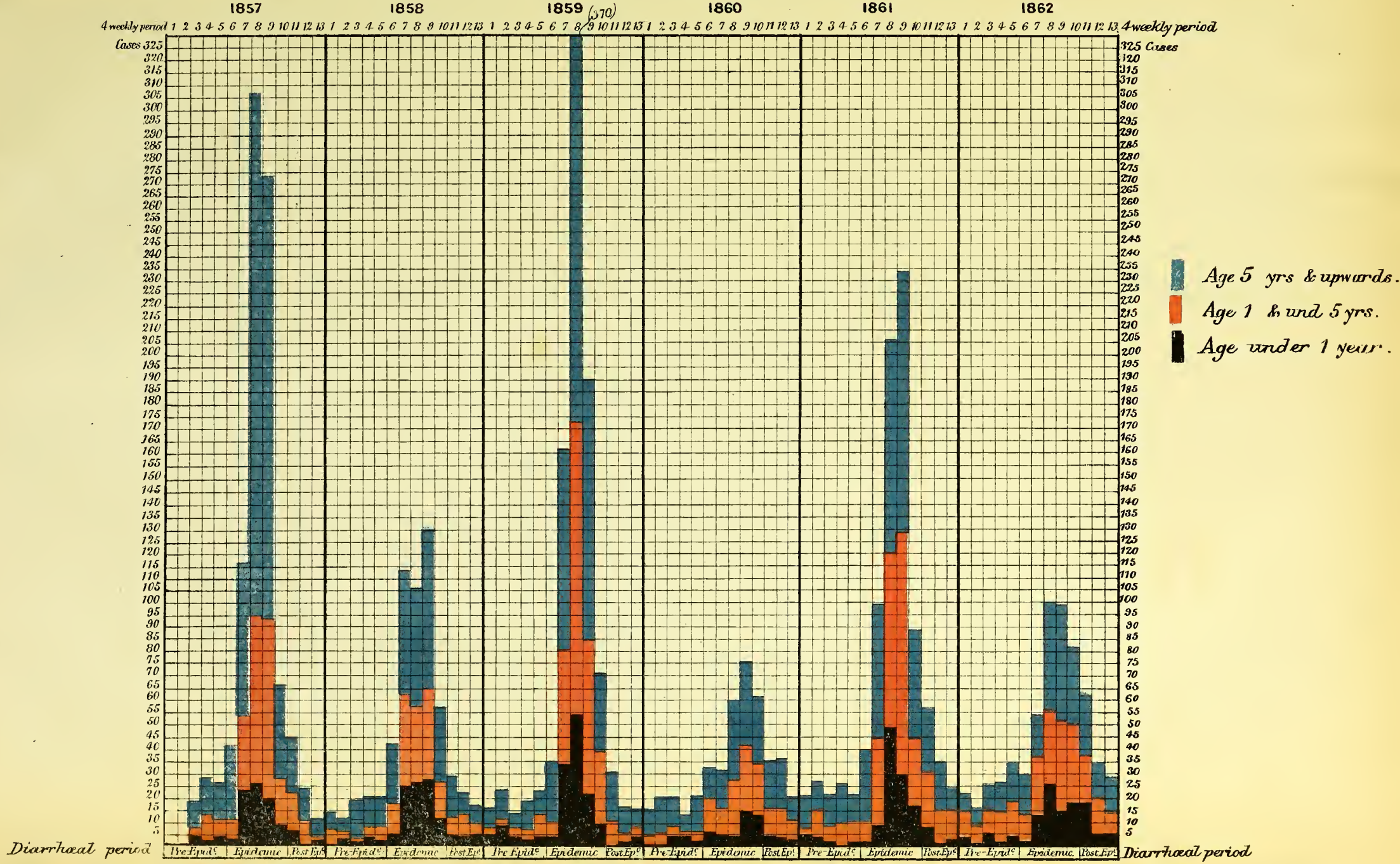
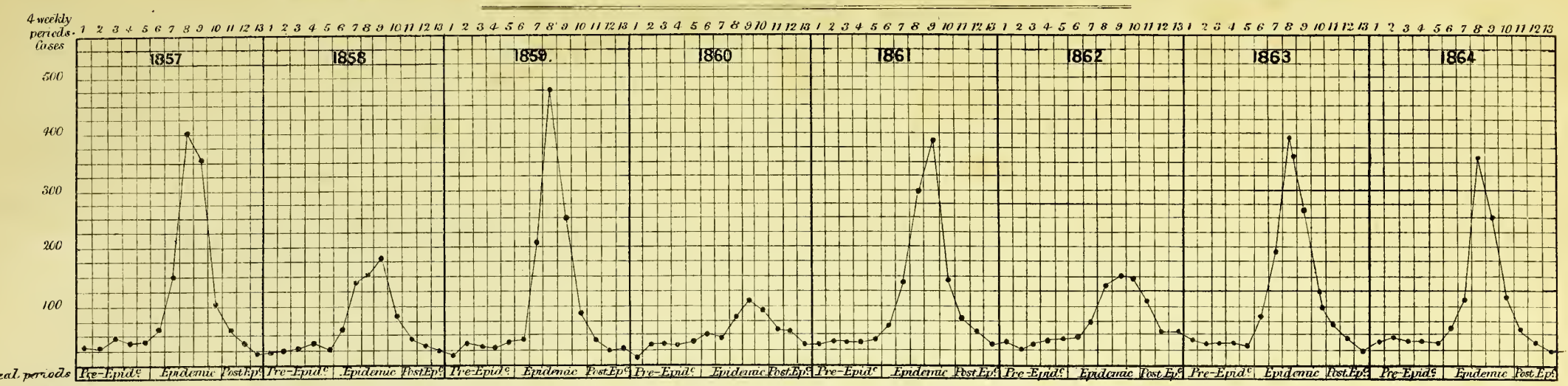
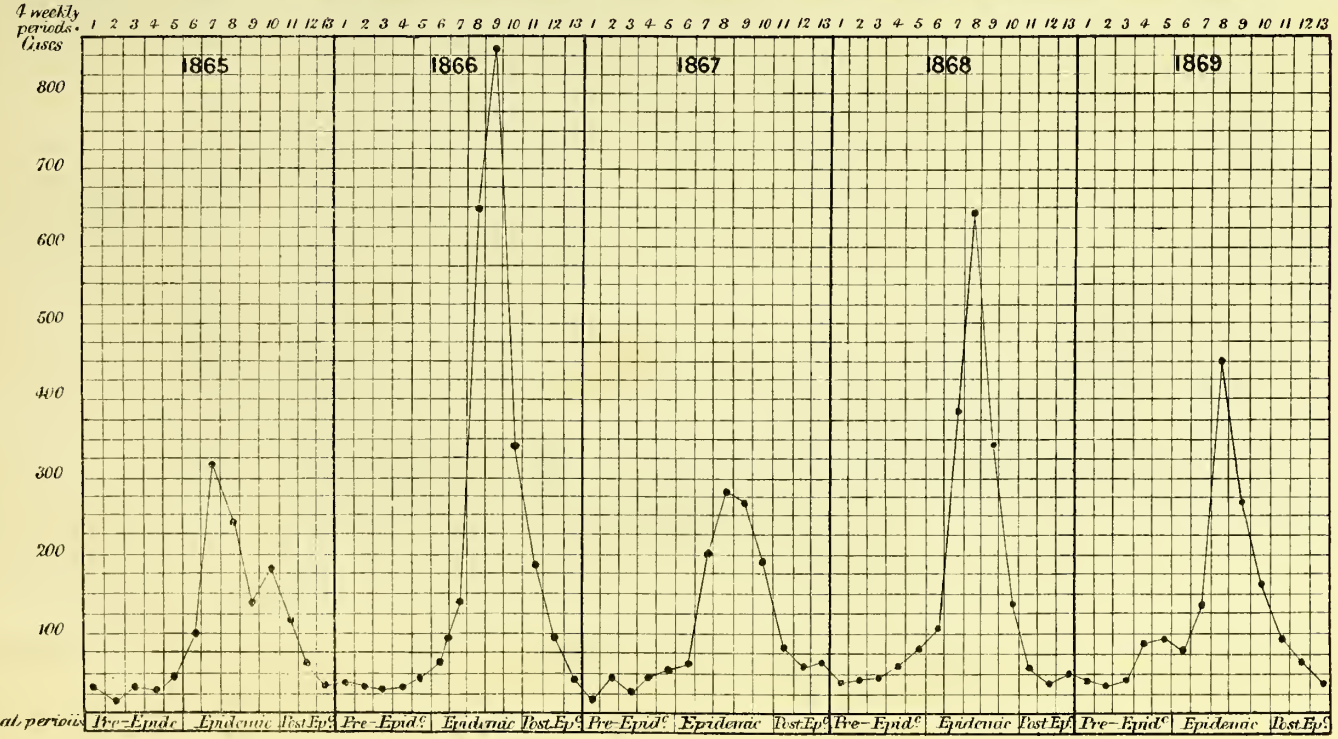


Chart V Showing the Number of Cases of Diarrhœa Newly Occurring in the Poor Law Medical Practice and Certain Medical Relief Institutions at Islington, in Each 4-Weekly Period of 13 Years 1857 to 1869. (All Ages.)

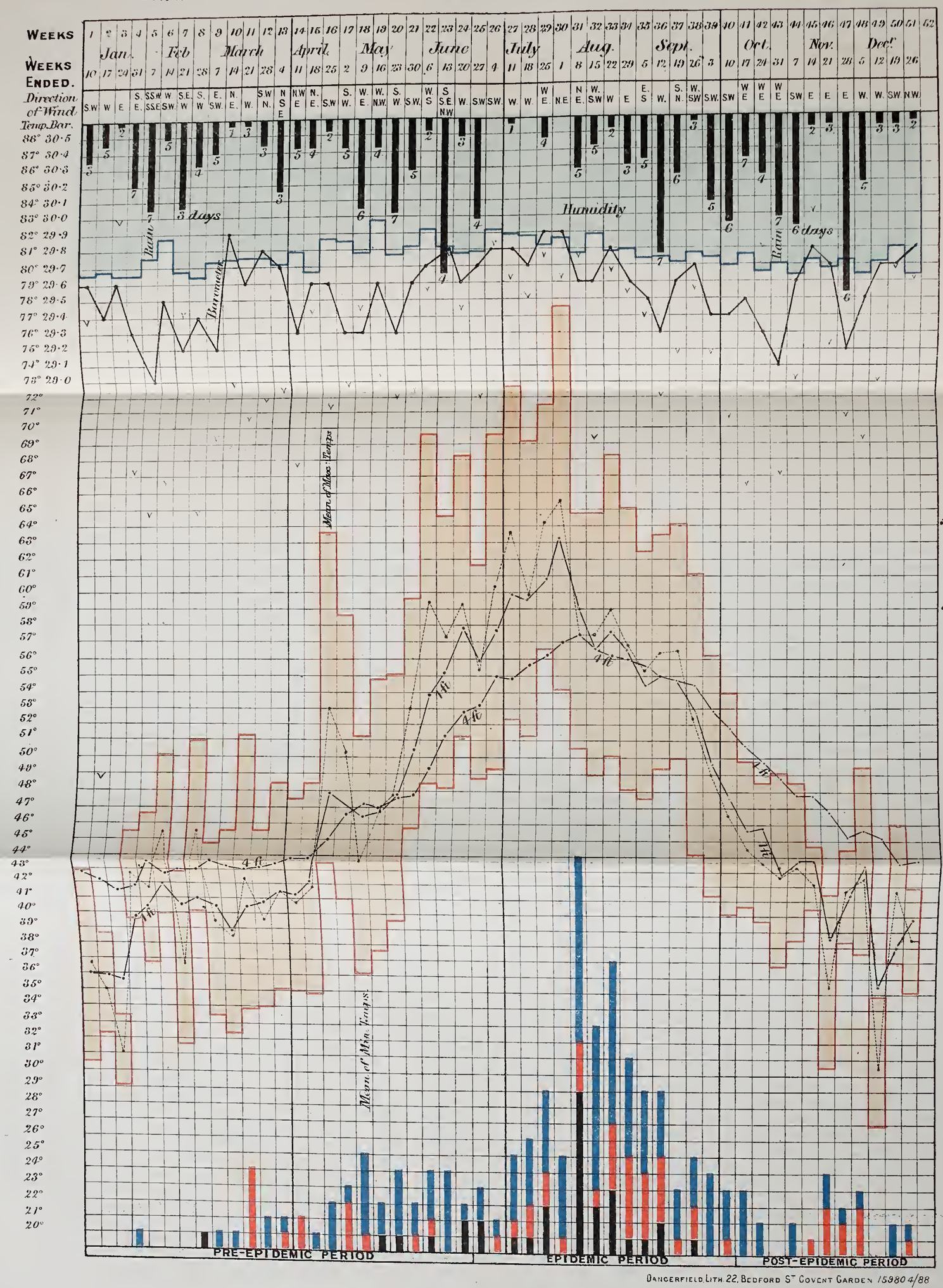




Janlerfield Lth 22, Bedford St Covent Garden 1879 8/88

[To follow p. 77.]

CHART VI. REDDITCH. DR PAGE'S CASES OF DIARRHŒA 1885.



DANGERFIELD LITH. 22, BEDFORD ST COVENT GARDEN 15980 4/88

APPENDICES.

Causation of "Diarrhœa," by Dr. Ballard.

APPENDIX A.

Dr. Klein's Microscopical and Pathological Investigations, together with Records of Hospital Cases.

The following are abstracts of eight fatal cases of "diarrhœa" in which various viscera were examined microscopically by Dr. Klein:

Case 1. (Victoria Hospital for Children, Chelsea.) M., aged 4 months, was well until Saturday, 16th July 1881, when he was taken ill with vomiting and vomited twice that day. The child got better and on Tuesday the 19th was quite well during the day, but had diarrhœa in the evening. On the Wednesday morning he was better and the motions were partly formed, but at night was very restless and the diarrhœa recurred. On Thursday he was very weak and apparently in great pain, dozed during the day, but had not much diarrhœa; and what there was was greenish and watery. He died suddenly in the evening.

Autopsy, 17 hours after death. Body thin and pale. Intestines pale; a few hyperæmic streaks along the mesenteric margin. The mucous membrane of the small and large intestines covered with a thick layer of creamy catarrhal exudation. Mesenteric glands much enlarged and hyperæmic. Spleen large; the lymphatics of the hilus enlarged. Liver pale. Both lungs show hypostatic pneumonia in the posterior portions of the lower lobe; lung tissue dense. A few drachms of clear serum in the pericardium; no distinct inflammation. Heart normal. Kidneys pale.

Microscopical examination.—*a.* Intestinal exudation.—It contained numerous micrococci, pus cells, and numerous detached epithelial cells. Beside these it contained highly refractive spores of bacilli in dumb-bells and in four, and also numerous bacilli. *b.* Pericardial exudation.—It contained a great deal of fibrin and a few detached epithelial cells, but no definite organisms. *c.* Kidneys.—Glomerulo-nephritis; hyaline degeneration of some Malpighian corpuscles; small collections of round cells near the outer capsule of the kidney and also along the arterial branches. Many convoluted tubes contained extravasated blood; the cavity of the Malpighian corpuscles contained albuminous transudation. The epithelium of many of the tubes of the cortex opaque and swollen; fatty degeneration and granular disintegration in some tubes. (Severe acute parenchymatous and interstitial nephritis.) *d.* Lung.—In the parts that showed inflammation to the naked eye, the alveolar walls were much thickened owing to the presence of round cells; in some of the alveoli, catarrhal cells; accumulation of round cells around the arterial vessels. The blood capillaries of the alveoli much distended and filled with blood. (Acute interstitial and catarrhal pneumonia). *e.* Liver.—Uniform pigmentation of the liver cells. In some parts the inter-lobular connective tissue contained a few round cells. Slight indication of fatty degeneration of the liver cells. *f.* Mesenteric glands.—Peculiar enlarged (inflammatory) cells in the cortical sinuses and in the cortical follicles; in the latter they were seen in groups. *g.* Small intestines.—Epithelium of surface and of the Lieberkuhn's crypts in most places altogether gone; the tissue of the villi and of the whole mucosa thickened by the increase in number and size of the lymph corpuscles. *h.* Large intestine.—The same as in small intestine. *i.* Spleen—No definite change.

Case II. (Victoria Hospital for Children, Chelsea). F., aged 18 months. Was quite well in the morning on September 18th, 1881. Ate an over ripe pear at 10 a.m. and immediately afterwards was seized with violent vomiting. Vomited again at 1 p.m. Diarrhœa began soon after this, and the evacuations grew more frequent and more watery during the afternoon. Was admitted into hospital at 10 p.m. very pale and in convulsions. The motions were frequent, liquid, dark, and offensive. Breathing irregular. Died at midnight.

Autopsy, 13 hours after death. Strongly built, well nourished child. Cerebrum, and cerebellum hyperæmic. Both lungs much congested and in parts collapsed. Liver very full of blood. Spleen looks normal. Both kidneys much congested. Some of the mesenteric glands enlarged and red. Mucous membrane of stomach hyperæmic with a few spots of ecchymosis. The solitary and agminated lymph follicles of the whole intestine very distinct, the mucous membrane around them being also slightly swollen. Patchy hyperæmia in descending colon and rectum.

Microscopical examination.—*a.* Blood.—Taken from right ventricle, dried on glass, and stained with aniline (gentian violet) showed many red corpuscles surmounted by a pale

homogeneous stained zone of a jelly-like substance which was evidently semi-coagulated plasmine, as would occur on imperfect coagulation of the blood. It appears therefore that, probably owing to great inspissation of the blood during life, it did not coagulate, but the plasma assumed a sort of jelly-like appearance. *b.* Lungs.—Showed acute catarrhal pneumonia; the capillaries of the alveoli much distended and filled with blood; alveolar cavities contained in many places detached and degenerating epithelial and pus cells and in some places there was also albuminous exudation. In the bronchi the epithelium was becoming more and more detached. *c.* Liver.—Blood capillaries much distended with blood; liver cells loosely connected with one another. In many places fatty degeneration of the liver cells. *d.* Kidney.—Intense parenchymatous nephritis in all parts; the space of Malpighian corpuscles distended by coagulated albuminous transudation; the convoluted tubes contained the same transudation, and their epithelium was opaque and in a state of granular disintegration. *e.* Spleen.—General swelling of the pulp owing to its being filled with blood. *f.* Mesenteric glands.—Inflammatory enlargement of cortex and medulla: there were in many parts both of cortex and medulla peculiar spherical globules in large number; they were of very various sizes, the largest only about a half or a third the size of a blood corpuscle, and they ran from this size to that of a minute granule just perceptible. These granules stained deeply like the substance of the nuclei, and were present also within the blood vessels, within cells, and within the fibres of the reticulum. *g.* Stomach.—Hyperæmia and swelling of gastric mucous membrane; the epithelium of the surface all gone, that of the gastric glands loose and partly broken down. Numerous round cells in some places of the mucous membrane. *h.* Intestines.—The epithelium of the surface was gone as a whole; that of many Lieberkuhn's crypts loose and partly detached. The vessels of the mucosa distended; numerous round cells abnormally present in the mucosa. In the blood vessels occurred the same granules and globules mentioned above as having been found in the mesenteric glands; they were also found in the solitary lymph follicles of the large and in the Peyer's glands of the small intestine.

Case III. (Manchester Children's Hospital, Pendlebury.—Clinical history and autopsy by Dr. Ashby. Reference Number in Case-book 410 L. "Abstract of case in Sanitary Record, October 15th, 1880.") P. S. Male, aged 5 years and 3 months, admitted 23rd August 1880.—Was quite well last night till he went to bed. About 1 a.m. this morning he began to be purged and to vomit, and this went on for 5 hours. Directly he swallowed anything he was sick. It is not known that he had any fruit during the 22nd. He has been much worse, and apparently in a dying state for last two hours. A fairly nourished child, On admission he was in a state of collapse, eyes sunken, pupils contracted, conjunctivæ almost insensible, lips pale, pulse 140, and can hardly be felt at the wrist. Temp. 104°, Resp. 55. There had been no motion passed since 11 a.m., when it was "sago-like." Brandy and Sp. ammon. aromat. given continually without much effect, and nitrite of amyl was inhaled. This seemed for a short time to bring colour to his lips and made the pulse at wrist perceptible, but he very soon relapsed into the same state. He never really rallied, and died quietly at 2.45 p.m. Duration of illness about 14 hours.

Autopsy, 22 hours after death. Rigor mortis very marked. Body well nourished. *Brain* congested and soft. *Lungs* natural. *Heart*, left ventricle firmly contracted, right side contained a fibrinous clot, and was not distended. Valves healthy. The blood in the veins semi-fluid in consistence. *Abdomen*, the intestines were very dry and sticky, moderately distended with gas. They contained but a very small quantity of fæces of pale colour, and rather powdery, and some mucus. Stomach contained a semigelatinous fluid in small quantity, was congested, with slight extravasation opposite the entrance of the oesophagus. The duodenum had a pale pinky colour. Peyer's glands were enlarged and red. The solitary glands in the stomach and the small intestines were enlarged. The whole intestines presented a sodden appearance. *Liver* and *kidneys* apparently sound. *Spleen* rather soft. *Thymus gland* very much enlarged.

Microscopical examination of viscera after having been hardened and preserved in spirit. By Dr. Klein. *a.* Kidney.—Severe parenchymatous nephritis; glomerulo-nephritis; albumen in Malpighian corpuscles. Granular matter in convoluted tubes, and swelling and granular degeneration of their epithelial cells. In some places there is a collection of round cells around Malpighian corpuscles. In the papillary portion of the kidney, the large urinary tubes had lost their lining epithelium. The capillaries of the peripheral part of the cortex of the pyramids were distended or filled with blood. *b.* Spleen.—Hyaline degeneration of the arteries to a remarkable degree; total collapse

Causation of "Diarrhœa," by Dr. Ballard.

of some arteries. Pulp much congested. *c.* Liver.—Much congested, the capillary blood vessels of the acini being distended and filled with blood in many places. The liver cells show commencing fatty degeneration. *d.* Stomach.—Epithelium of surface of the mucous membrane entirely gone; the gastric glands show their epithelium loosened and partially broken down; the lymph follicles showed a very remarkable swelling, with necrosis in their centre.

Case IV. (Children's Hospital, Pendlebury.—Abstract of clinical history and autopsy by Dr. Ashby. "Sanitary Record, October 15th, 1880.) Child, aged 2½ years, who had been ill more or less for three weeks, with vomiting and purging, and in whom for the last few days of life the symptoms, especially the vomiting, were very severe. The following condition was found at the—

Autopsy.—Stomach contained some altered blood and there was capillary injection of the mucous membrane. Intestines contained much gas, the mucous membrane was pink from capillary distension; no ulceration, no lesion of Peyer's patches, slight hæmorrhage from congested vessels. The liver somewhat small (7 oz.; body weight 17½ lbs.), pale, evidently very fatty, lobules distinct, central portion light red, outer zone white. The microscope showed the cells distended, with fat globules obscuring the nucleus and at times filling the cells; some crystals, apparently leucine, noted. Kidneys normal [apparently they were not examined microscopically]. Brain and other organs normal.

Microscopical examination by Dr. Klein was limited to the only portion of viscera sent him hardened and preserved in spirit. Liver.—It showed complete fatty degeneration of the liver cells in all parts. Some of the intra-lobular veins collapsed.

Case V. (Children's Hospital, Pendlebury.—Case Book, Ref. No. 537 L), D.E.M. Male, aged 1 year 3 months, admitted 8th August 1881.—Has had "bronchitis," then whooping cough and bronchitis, with ulcer under tongue. Abscesses in neck followed, and a short time ago diarrhœa with blood and slime. Bowels still relaxed. Since last two days child has been heavy, feverish, thirsty, vomiting, and coughing. Then came a sudden change.—An unhealthy looking child, with distressed face, small attenuated body, eyes rather sunken, and lashes long, no sign of presenting teeth. Frequent greenish yellow diarrhœal motions, 14 or 15 per diem, with frequent sickness. Nothing about chest or abdomen. Has frequent complaining cry. Subsequently diarrhœa lessened to four or five stools per diem. Aug. 13. Constant diarrhœa and sickness. Aug. 15. Diarrhœa not cured. Sickness once in night, but has retched often. Only very small quantities of nourishment had been taken during the last 48 hours. Extremities cold, very apathetic, abdomen soft not tender. No optic neuritis. Resp. quiet, pulse 148. Aug. 17. For the last 48 hours condition not much changed. Lies with half-closed eyes and never cries. Scarcely makes any resistance when disturbed, but throws its arms about a little at times. Opens its mouth to take food. No sickness or diarrhœa. No optic neuritis is made out. Child takes only slight notice of what goes on round it. Aug. 18. General condition not much changed; still very apathetic. Pulse of moderate strength and regular, 148. Resp. regular, rather deep drawn, 28. Face twitches occasionally (both sides together). Alæ nasi dilate slowly. Abdomen soft, wasted, and retracted. Coughed a little in the night, was sick once, and retched several times. Cried a little. Is not anæmic. Aug. 19. General condition worse. Bowels opened twice in the night. Coughs feebly occasionally. Extremities warm. Was thought to be worse in the night. Pulse 148, regular. Resp. 32, regular. Attempt to see discs not successful on account of inversion and upturning of the eyeballs. Lies quite still, shows little consciousness of being disturbed. Abdomen soft, not markedly retracted. Has passed 12 motions. Pulse 140. Resp. 32. Looks somewhat less comatose, but takes no notice. Aug. 20. Pulse 156, counted with difficulty. Does not take milk so well. Drowsy. Dilation of alæ nasi. Pulmonary rhonchus on both sides in front. Deficient resonance in lateral regions and base in front. Marked dulness with well marked bronchial breathing over lower two-thirds on right side behind. A few moist râles at left base. Has wasted very much. Scalp viens more distinctly seen, perhaps on account of the wasting. A patch of ulceration on lower segment of left cornea. Died Aug. 20. [For temperature chart, *see* end of Appendix.]

Autopsy.—Brain normal. Right lung, generalised catarrhal pneumonia in lower two thirds; small intestine congested; colon throughout whole length congested, mucous membrane thickened, universal follicular ulceration, small ulcers size of hemp seed.

Causation of "Diarrhœa," by Dr. Ballard.

Microscopical examination of portions of viscera hardened and preserved in spirit. By Dr. Klein. *a.* Kidney.—Showed large numbers of homogeneous casts in the collecting tubules both of the cortex and of the pyramids; in the cortex many of the convoluted tubules showed granular swelling with fatty degeneration of their epithelium. In this case the parenchymatous nephritis has evidently lasted longer than in any of the former cases [Dr. Klein had not the history of the case before him when writing this]. *b.* Lung.—Showed in places the appearances of acute pneumonia; the blood vessels of the alveolar walls much distended by and filled with blood, the alveolar cavities containing blood, round cells, and detached epithelial cells. *c* Large intestine.—The epithelium of the surface of the mucous membrane is gone; the epithelium of Lieberkuhn's glands loosened and partially detached or gone; the mucous membrane thickened by the presence of round cells.

Case VI. (Children's Hospital, Pendlebury. — Case Book Ref. No. 585 S.) — J. M. Male, age 4 months, admitted 22nd August 1881.—Fed on breast and cow's milk. Diarrhœa commenced on night of Aug. 18. Last night purged 6 times. On admission, pale, cold, almost pulseless. Eyes half closed. Loose stool 5 or 6 times daily. Has recovered a little. Breathing very rapid, dulness at both bases. Both sides of chest full of crepitant râles behind. Aug. 24. Diarrhœa suddenly increased yesterday afternoon, but soon ceased. Breathing very rapid, and pallor increased. Aug. 25. A little dulness at each base behind. Crepitation a little higher on right than on left. Bowels opened twice in night. Rigidity of arms and legs. General appearance improved. Pulse 160. Aug. 26. Abundant moist râles at both bases behind, and bronchial breathing as well. Sick once, but now takes food well. Aug. 27, Copious crepitation on both sides. Aug. 29. Copious large crepitant râles both bases. Air enters well elsewhere. Coughs a good deal. Pulse 176. Respiration 60. On the whole a little better. 7 p.m. Has moaned and had a little twitching about the mouth. Aug. 31. Crepitation not so loud and large but extends a little higher. Dulness at apices, but no râles or bronchial breathing there. Not so well last night, but better this morning, and takes milk well. Bowels open. Ice bag to head last night while temp. is high. Pulse 156. Respiration 36. Sept. 1. Ice bags to head and abdomen last night between 10 p.m. and 12 m. reduced temp. from 105° to 98°. There was much rigidity of arms. Has taken food well. Abundant crepitation still at bases. Pulse not easy to count at wrist. Heart's action regular. Breathing less noisy and less rapid. Takes no notice. Sept. 2. Bronchial breathing at right base, hardly any râles. Hardly any air enters over right front, which is dull. Pulse 164. Urticaria over abdomen where the ice bag was applied. Sept. 3. Still very pallid, but on the whole not worse. Crepitation both sides behind, and bronchial breathing over a limited area on the right side. Crepitation in front on right side. Very little healthy breathing anywhere. Takes milk well. Takes a little notice. Coughs occasionally. Sept. 5. More pallid and somewhat wasted about the face. Takes food well. Pulse fairly strong. Respirations usually somewhat catchy. Motions at times a little relaxed. The only pulmonary sound on the left side is a little moist râle at the left base. On the right side in front hardly any respiratory sounds are to be heard, but there is a friction sound and a few moist râles. Behind there is dulness and copious crepitation at base with tubular breathing higher up. Sept. 6. Dulness, bronchial breathing, and abundant crepitation all over right lung behind. Bronchial breathing, crepitation, and impaired resonance at left base. Rhonchus over right front, friction not heard. Rather more pallid, but does not waste. No diarrhœa. Takes food well. Sept. 7. Died 3.45 a.m. [For temperature chart, *see* end of Appendix.]

P.M. Sept. 8. Double basic catarrhal pneumonia. No tubercle. Soft congested liver. Spleen natural. Heart natural. Kidneys pale. Some follicular ulcers in large intestine. Head not examined.

Microscopical examination of portions of viscera hardened and preserved in spirit. By Dr. Klein. *a.* Liver.—Complete fatty degeneration of the liver cells of the whole liver; in some of the inter-lobular veins and in some of the capillaries of the acini plugs of beautiful micrococci; there are also micrococci in some of the inter-lobular lymphatics. *b.* Lung shows large pneumonic patches, the alveoli being filled with blood and round cells; in some the stage of red, in others of grey hepatisation being observable. *c.* Kidneys. — Hyaline casts in many collecting tubules, both of the cortex and of the pyramids; the epithelium of some of the convoluted tubes granular and swollen; in numerous other convoluted tubes it has undergone fatty degeneration. Clumps of micrococci in some of the large blood vessels. *d.* Large intestine.—Total loss of epithelium of the surface of the mucous membrane; partial detachment and

Causation of "Diarrhœa," by Dr. Ballard.

loss of the epithelium of Lieberkuhn's crypts; the mucous membrane swollen and containing abnormally numerous round cells.

Case VII. (Children's Hospital, Birmingham.—Clinical history and autopsy recorded by Dr. Welch.)—A. H. G. Male, aged 12 months. Residence situated in a healthy country lane, with no other dwellings near, and said to be well-ventilated, but the walls and brick floor of the house are said to be damp. Is said never to have been thoroughly well, but to be habitually cheerful. No history of bronchitis or of laryngismus. Had thrush two weeks before admission. Has been always suckled, and occasionally had a little bread and milk, but no other food. On July 15, 1882, at 11.30 a.m., was suddenly seized with vomiting and purging, which continued at intervals until admission into hospital at 7 p.m., July 17. The child looked healthy and strong; was restless, with an expression of uneasiness in the face; somewhat pale; eyes and mouth partly open during sleep, which happens at intervals. Frequently screams, and draws legs up, but ceases to cry if the abdomen be rubbed with the hand. Nothing abnormal in the chest; breathing chiefly abdominal. Pulse 120; respirations 44. Abdomen somewhat distended, soft, not tender, and pressure seems to relieve pain. Lips and mucous membrane of mouth dry. No stomatitis. Takes milk freely from the bottle. No vomiting. Five stools on day of admission; pale yellow in colour, semi-liquid, and with acid reaction. Has very little pain at the time of passing a motion, but cries, as if in pain, previous to an act of defæcation. Urine passed in bed, so that quantity cannot be estimated. July 20. Appears more feeble, and has had 11 motions during 24 hours. Pulse 130; respiration 40. July 24. Diarrhœa still continues; becoming weaker. The stools numbered from one to five daily from July 24 to August 4, when they rose to nine. There were 11 stools on the 5th; 10 on the 6th. August 7. Condition worse than formerly; nine stools this day; vomits. Up to this date fed upon pancreatised milk. Milk food discontinued, and simple milk and water, with half an ounce of brandy per diem, given from a bottle. Cries out as if in pain. August 8. Continues to become weaker. Six stools this day, and vomiting still continues. Lies in a listless state. Kicks off all the bed-clothes, and will not allow them to remain over him for a minute. Rejects all food. Moans at intervals. Died at noon of August 9, not rallying from listless state.

Autopsy 48 hours after death. Body somewhat emaciated; surface very pallid. A little hypostatic congestion posteriorly. Abdomen flat and retracted. *Abdomen.* Peritoneal surface if anything somewhat drier than usual. No trace of inflammatory mischief. Liver remarkably pale and bloodless; no blood escaping from cut surface; weight, 8½ ozs. Gall bladder full of green bile. Spleen somewhat turgid; substance firm, and of a deep chocolate-brown colour; weight, ¾ oz. Kidneys extremely pale, but otherwise looked healthy; capsules stripped off easily; weight of the two, 1½ oz. Stomach full of undigested food, partly liquid, but with hard firm milk curd in it. Walls bloodless. Mucous membrane towards cardiac end thickened and pulpy; towards pyloric end softened, as if the epithelial layer had been cast off. In this part the vessels in the submucous layer are marked by altered and sooty coloured blood, giving the surface a streaked appearance. Intestines, small and large.—Below the duodenum almost perfectly empty, the mucous membrane only being coated with yellow fæcal matter. Through much of the length, the intestine is firmly contracted, and in several spots in the ileum there are short invaginations. Walls of intestines pallid. Mucous membrance pale, otherwise normal. Peyer's glands full. No ulceration obvious anywhere. *Thorax.*—No fluid in pleuræ or pericardium; surface of both dry. Heart; right cavities full of a currant-jelly-like clot; left cavities empty and fully contracted; substance and valves healthy. Both lungs for the most part pale and bloodless. At posterior base of right lung there is a patch of superficial pneumonic consolidation not extending more than ¼ inch into lung substance. In left lung there are in both lobes similar small patches of consolidation. *Head* not examined. (For Temperature Chart, *see* p. 16.)

Microscopical Examination by Dr. Klein.—*a.* Kidney.—Glomerulo-nephritis. In some convoluted tubes opaque swelling of epithelium, in others granular degeneration and breaking down. Few homogeneous casts in tubes of cortex. *b.* Liver.—Complete fatty degeneration of the liver cells in almost the whole liver. *c.* Lungs.—The blood vessels of the pulmonary pleura, and near the pleura, much distended with blood, and there is hæmorrhage into the pleura. In some parts the air-cells of the hardened specimen sent for examination were filled with granular material (coagulated albumen)—acute œdema; the blood vessels of the alveolar wall distended by blood. In other parts beside the vessels being distended with blood, the air-cells contained, in addition to the

granular matter (coagulated albumen), numerous round cells, blood corpuscles and detached epithelial cells. There were clumps of micrococci in some of the air-cells. *d.* Spleen showed much congestion. *e.* Mesenteric glands.—The cortical follicles much enlarged, and contained foci of granular and fatty degeneration. *f.* Stomach.—Congestion of the mucous membrane; the epithelium of the surface and of the ducts of the gastric glands entirely gone; the epithelium lining the glands loosened in many places; the cells themselves in some tubes in a state of granular degeneration and breaking down. *g.* Intestines.—Mucous membrane much thickened owing to an abnormally large number of round cells in it; the epithelium of the surface gone entirely, as well as that of the mouths of the Lieberkuhn's crypts; the rest of the epithelial lining of the Lieberkuhn's crypts loosened in some places.

Case VIII. (Children's Hospital, Birmingham.—Clinical history and autopsy recorded by Dr. Welch.) F., aged 15 months. Admitted from Navigation Street, Birmingham, at 5 p.m., August 10, 1882. The house where the child resides stands in a broad street, and the family, consisting of five persons, occupy a room on the first floor over a shop night and day.—Of cheerful disposition, but said to have been delicate from birth, and is unable to walk. Had whooping-cough when six months old, and suffered from some constitutional derangement when teething. Dentition commenced at age of seven months; eight teeth had been cut on admission. Both fontanelles patent. Has been suckled ever since birth, and is not yet weaned, but in addition has had three times daily such food as bread, tapioca in the form of puddings, a pint or less of cow's milk, and sometimes some chopped meat; has always had enough. The illness came on suddenly at 8 p.m. on Wednesday, August 9. It began with vomiting, which was shortly after accompanied by diarrhœa, the latter becoming subsequently more frequent. On admission the general nutrition of the body was found to be fair; gums slightly swollen over the uncut teeth. Child very feeble and exhausted, lying listlessly in the mother's arms, and constantly moaning. Temperature *sub*-normal [actual temperature not stated in the report]. Hands and feet cold. Pulse small, almost imperceptible. Face small, pinched, and pallid. Eyes sunken, and surrounded by areola, and imperfectly closed during sleep. Occasional convulsive movements; hands clenched, and legs drawn up and kicked out again. Pain also indicated by restlessness and screaming. Chest well formed; respirations chiefly abdominal; normal in other respects. Abdomen retracted, soft, and not very tender on pressure. Tongue and mucous membrane of mouth pale and dry. No appetite for food. Milk, given every half hour, mother says is vomited almost immediately; vomited matters consisted of curdled milk. Purged soon after any food: stools watery and brown coloured; defæcation apparently painless, and without straining. Urine reduced in quantity, but of normal colour. The child became comatose at 10 p.m., and died at 11.30 p.m., after an illness of 27½ hours.

Autopsy 12 hours after death. Body well nourished, marked congestion of posterior surface and of extremities. Abdomen flattened. *Head.*—Calvarium thin; anterior and posterior fontanelles open. Venous sinuses and cerebral veins full and congested. No excess of fluid. Brain weighed 2 lbs. 7 ozs., substance soft, ventricles contained but little fluid; veins in substance, choroid plexus &c. full of blood. *Abdomen.*—Peritoneal cavity dry. No trace of inflammatory action, but here and there veins on peritoneal surface of small intestines full. Liver weighed 8½ ozs., congested, blood running freely from cut surface which otherwise was apparently normal. Spleen weighed 6 drachms, full, congested, and plum-coloured. Kidneys apparently healthy, weight 1½ oz. Stomach apparently healthy and mucous membrane normal; contained some yellow pultaceous matter. Pancreas healthy. Small intestines empty; mucous membrane apparently normal; no congestion and no ulceration of Peyer's patches. Intussusception in four places, the lower portion of the canal being pushed into the upper portion and slight fulness of the vessels around each. Large intestines normal containing a little fæcal matter; no congestion or ulceration. *Thorax.*—No fluid in pleuræ and no adhesions. Left lung, anterior border collapsed leaving pericardium exposed. Lungs both weighed 4½ ozs. Right lung had upper lobe normal, lower lobe was congested with a hæmorrhagic spot on posterior margin. Left lung had upper lobe partially collapsed, lower lobe congested, and margin in places thoroughly collapsed; slight superficial pneumonia in places. Heart normal, valves healthy, left ventricle and auricle filled with blackish fluid blood; no clots.

Microscopical Examination by Dr. Klein. *a.* Kidney.—Severe glomerulo-nephritis. In almost all the convoluted tubes the epithelium showed opaque swelling and granular

Causation of "Diarrhœa," by Dr. Ballard.

degeneration, numerous hyaline casts in the collecting tubes of the cortex only. In some Malpighian corpuscles there is present a small amount of granular transudation. *b.* Spleen.—Congestion of the pulp, swelling of the Malpighian corpuscles, and degeneration of the central portion of some of them. *c.* Liver.—Congestion of the acini; commencing fatty degeneration of the liver cells. *d.* Lung.—The blood vessels of the pleura and lung much distended; the air cells filled with granular matter and blood corpuscles. In some parts there are round cells both in the alveolar cavities and in the alveolar wall.

Other portions of hardened and preserved viscera from children who had died from diarrhœa during 1883 in the Children's Hospital at Birmingham, were forwarded to Dr. Klein in separate bottles for examination, but they were not labelled in such a way as to enable me to identify the cases they were derived from. I append the results of Dr. Klein's examination of the contents of two of these bottles which alone were worth examining, the others consisting merely of bits of stomach and intestine:

A.—*a.* Lung.—Showed patches of inflammation; this proved to be typical grey hepatization, the air vesicles in part being filled with pus-corpuscles. *b.* Kidney.—Glomerulo-nephritis; albumen in the Malpighian corpuscles. Granular degeneration of the epithelium of the convoluted tubes of the cortex, a few of these tubes containing hyaline casts. *c.* Liver.—Uniform fatty degeneration of the liver cells. *d.* Stomach.—Epithelium of internal surface gone, but otherwise no change.

B.—*a.* Kidney.—Glomerulo-nephritis, albumen in Malpighian corpuscles, few hyaline casts in tubes of cortex. *b.* Lung.—Small patches of catarrhal pneumonia, in some circumscribed parts air vesicles collapsed. *c.* Liver.—Shows uniform fatty degeneration of the liver cells. *d.* Spleen normal.

In none of the specimens thus sent was there any organism present either in the tissues or blood vessels.

The following is Dr. Klein's record of the only case in which he has found a micro-organism on post mortem examination:—

"The case was one of typical acute summer diarrhœa admitted into the hospital in Great Ormond Street, and which ended fatally with fits of eclampsia. In the cavity of the intestine there were found numerous mobile bacilli which in size and shape bore a certain resemblance to the bacilli known as occurring in typhoid fever. These bacilli were also found on microscopical examination of sections of the swollen mesenteric glands, but were not numerously present there. From these glands cultivation experiments were made on nutritive gelatine; the bacilli were thus isolated and pure cultivations obtained. Comparing these cultures with those of the typhoid bacilli of Gaffky a striking resemblance is noticed. *a.* They look alike in microscopical specimens. *b.* They grow alike in plate cultivation. *c.* They grow alike in broth. *d.* They are very much alike in stab and streak cultures on gelatine and on agar-agar mixture.* Comparing the two in respect of their action on animals, it is found that when inoculated into white mice they produce in a large per-centage of cases death under septicæmic appearances; the bacilli could be recovered from the heart's blood by cultivation. The differences between them so far as I can at present see are: (1) That this bacillus from the case of infantile diarrhœa grows on gelatine more rapidly than Gaffky's typhoid-bacillus, and (2) that the former has a somewhat greater resisting power to the action of perchloride of mercury than the latter.—E.K." *See* Plate at end of Appendix.

Examination by Dr. Klein of Blood taken during Life from Cases of Diarrhœa treated at the Children's Hospital, Birmingham.

Specimens of blood collected in Husband's capillary tubes, which were then sealed, were at my request forwarded to Dr. Klein for microscopical examination. They were collected from altogether 11 cases: of seven of these I have been furnished with a clinical record by Dr. Welch. One of the cases was Case VII. above, the remaining six were the following:

Case IX.—L.W., female, aged 1 year and 6 months, admitted July 14, 1881. Father (a caster) has been out of work since Whitsuntide, and mother only earns seven shillings a week. She sleeps with father and mother in a room of good size, but as mother goes out to work she spends the day with a grandmother in the kitchen of the house, but is said to

* There was a brief notice of this case in the Annual Report of the Medical Officer for 1886, p. 447.

Causation of "Diarrhœa," by Dr. Ballard.

be out in the yard (Pope Street, Birmingham) a good deal. Was fed from the breast alone for first month, after that had boiled bread during the day and breast morning and night; weaned a fortnight ago. For the last six months, however, has had the same food as the rest of the family. Was taken ill on Tuesday, July 12, and vomited first on Tuesday night some "black stuff." Diarrhœa continued all day Wednesday, motions every half hour, green, and this went on until the admission into hospital. On admission was found to be fairly well nourished, face pale, and sunken look about the eyes. Skin healthy, except a little redness about the anus, and fairly clean. Tongue furred and white. All upper incisor teeth through and lower lateral incisors coming through. First molars quite through, canines beginning to appear. Mucous membrane of mouth healthy, but lower gums rather swollen with white patches. Not vomited since admission. Motions very frequent with only short intermissions. Stools partly yellow and partly green, mixed with urine passed in small quantities at a time, odour of stools not particularly offensive. Stools neutral in reaction when passed. Abdomen flaccid; and there does not seem to be much pain or tenderness. She does not cry except when disturbed, sometimes throws her legs about but does not draw them up. Liver and spleen not to be felt beneath the ribs and dulness not increased. Heart's action quick but regular. Pulse 140, small and weak. Lungs.—No dulness. Some râles over back of chest. Respirations 24, quiet and regular. Urine not obtained separately. Anterior fontanelle slightly depressed. July 16. Twelve motions in 24 hours, of which four during the night. Eyes still look sunken and face is getting thinner. Reaction of stools either neutral or slightly acid. July 19. Seven motions in 24 hours since last entry. Child looking better. Pulse 134; respirations 24. July 20. Seven motions in last 24 hours, green and slimy, slightly acid, and containing a little blood. Pulse 120, very weak; respirations 27. July 21. Temperature slightly below normal. Seven motions in last 24 hours, none as yet this morning, still bloody. July 23. Seven motions in last 24 hours, still bloody. July 25. Diarrhœa a little better, only four motions in 24 hours. July 26. Three motions in last 24 hours, yellow, no blood. Vomited a little yesterday. Takes milk often in small quantities. Pulse very weak and a little irregular; eyes still sunken. July 28. On examination of chest there was found dulness at both bases posteriorly, where are also fine crepitant râles; a patch of harsh bronchial breathing at right posterior base. July 30. Five motions during the last 24 hours; child lies very quiet, face pale and looks pinched; marked dulness at left base posteriorly and distinct bronchial breathing over a patch about an inch square; dulness also at right base with local crepitant râles, breathing slightly tubular. August 1. Eight motions in last 24 hours, stools dark coloured; seems very weak, and pulse feeble. August 2. Eight motions in last 24 hours, same as before. August 3. Died at 2 a.m. (For Temperature Chart, *see* p. 16.)

Autopsy.—Surface of body very pale, and slight cadaveric lividity on back. Small intestine pale, exsanguinous, and moderately distended. Large intestine contracted and empty. Mucous membrane of intestines bloodless, and no evidence of inflammation to the naked eye. A few small invaginations. Cæcum much distended, and contained yellow and greenish fæces. Liver weighs 10½ ozs.; both lobes apparently thickened; sections pale, fatty looking, and greasy. Gall bladder contained a drachm of yellow bile. Spleen weighs ½ oz., was firm on section, and of dark plum-red colour. Kidneys weighed each 1 oz. Both apparently healthy (but no microscopic examination was made). Pleuræ and pericardium moist, but without any excess of fluid. Left lung weighed 4½ ozs. Upper lobe crepitant, with the exception of a small portion at lower end; lower lobe solid throughout, non-crepitant, of a deep red colour, dotted here and there with grey specks. Right lung, upper lobe for the most part crepitant, but here and there a non-crepitant spot. Middle lobe in a perfect state of collapse, and airless; lower lobe, greater portion solid, with the exception of the inner and lower border, which was crepitant; solid portion of a deep red colour on section. Heart, right side contained a little fibrinous clot. Valves healthy. Head, dura mater firmly adherent to calvarium; a small quantity of fluid in lateral ventricles.

No microscopical examination of viscera made.

Case X. L. C., female, aged 1 year 8 months, from a court in Wheeler Street, Birmingham; house of two stories, said to be well ventilated and not damp. Child lived in kitchen during the day and at night slept in bedroom with two others. Habitually cheerful, and having had fair health previous to attack of diarrhœa. No history of previous illness. Began to walk at 11 months. Dentition commenced at 12 months, and has cut 11 teeth. Appears to have had sufficient nourishment. Was suckled up to

Causation of "Diarrhœa," by Dr. Ballard.

12 months. Food now taken is bread and milk, potatoes, occasionally a little meat, and about ½ pint of milk daily; but meals at irregular hours. Was taken ill suddenly at about 7 p.m. on August 18, 1882, with looseness of the bowels, which on the evening of 20th was followed by vomiting. This, however, soon ceased, but the diarrhœa remained persistent, the stools increasing in quantity and frequency. Admitted to hospital at 5 p.m., August 22. Body then seen to be fairly nourished. Pulse 100. Temperature 98·5.° No convulsions; restless during day, but sleeps well at night. Chest and respiratory system normal. Abdomen full, soft, and movements normal. Slight tenderness on pressure. Stools frequent; had three motions before admission, watery, green, and of an offensive odour. No straining. Urine said to be passed in normal quantity, acid, and contained little albumen. 23rd. Stools yellow, not very watery, odour offensive. Had a rash on the legs. 24th. Rash more marked; throat not congested. No change about stools. 25th. Bowels still moved frequently. Motions darker in colour, more watery, and offensive, and of an acid reaction. 26th. Stools watery and green. 27th. Looks livelier this morning, slept well, and diarrhœa better. Taken home by mother.

Case XI. F. P., male, aged 1 year and 2 months, from a court at back of Melton Place, Senof Street, Birmingham, a three-storied house, where family occupy a kitchen and two bedrooms. Child in kitchen during the day, but said to be taken out three times a day for an airing of about half an hour. Brick floor damp, and adjacent privy offensive. Rooms said to be well ventilated.—Prior to this illness fairly healthy, but suffered slightly from diarrhœa, soon recovered from, about five weeks before admission. Child habitually lively and cheerful. Dentition commenced at about 4 months. Began to walk at about 12 months. Suckled since birth up to the 20th August, when weaned. Fed on bread, about ½ pint of milk daily, sago, and occasionally a little oatmeal, and never any meat. Appears to have had sufficient food, but meals taken at irregular hours. Illness (date of commencement not stated) set in suddenly, with vomiting, for which some "teething powder" was given, after which there occurred frequent purging, the stools containing blood and slime. Admitted to hospital on August 21, 1882, when nutrition was found fair. Gums over uncut teeth not swollen. Much exhaustion. Pulse 115. Temperature 99·4°. Anterior fontanelle open, posterior closed. Face pale and pinched, eyes languid, mouth at times kept open. No convulsions. Very restless and peevish; draws legs up, and often cries out. Respiration thoracic; slight cough. Abdomen full, soft, tender on pressure. Tongue and mucous membrane of mouth pale and rather dry. Takes food well. No straining at stool observed. Stools very frequent on admission, watery, containing blood and slime, yellow, and of acid reaction. Urine passed in bed. 22nd. In same condition; very restless, and moans as if in pain. 24th. If anything worse to-day. Blood still in stools. 25th. Apparently better this morning, bowels less frequently moved, stools light coloured, watery, still offensive, and streaked with blood; quieter. 26th. Looking decidedly better this morning, slept better, stools green, and no blood. 28th. Stools darker, and less in quantity; very peevish. 30th. Not so fretful, stools about the same. From this time to September 15 child appeared to be improving, but on this day a rash appeared on the body, and he was removed to quarantine ward; but the next day, however, the rash had faded away. September 20th. Very poorly; motions again frequent and watery. 22nd. Motions increasing in number, very watery, and offensive. He is sinking. September 23rd. Died. No autopsy appears to have been made. (For Temperature Chart, *see* p. 16.)

Case XII. L. H., female, aged 14 months, from Broma Street, Lozells, Aston, a broad street open at rear; family occupy a two-storied house of two bedrooms and a kitchen, both of moderate size. Child in kitchen by day, and is rarely out of doors. Rooms said to be well ventilated, and walls and floor dry. Previous health tolerably good; is habitually cheerful, and no history of thrush, laryngismus, or bronchitic illness. No indications of defective development. Dentition commenced at 8 months. Suckled up to 8 months, when weaned. Food habitually was milk, bread, cornflour, and arrowroot, seldom any meat. Taken suddenly ill with diarrhœa on August 22, between 3 and 4 a.m. There has been no vomiting at all. Diarrhœa had been getting worse ever since. Blood first noticed in stools on August 30. Admitted to hospital at 4.30 p.m. on September 4. Nutrition of body fair, has four teeth cut, gums not swollen. No indications of exhaustion. Pulse 100. Temperature 98·6°. Anterior fontanelle open. Face rather pale. No convulsions. Child cross at times, but gives no signs of pain, and sleeps well. Respiration 30. No cough. Abdomen full, soft, and not

tender; movements natural. Takes food well. Stools described by mother to be frequent, large, watery, and containing slime and blood, green, and very offensive. After admission had only two motions, dark coloured, and offensive, but without blood. September 7th. Stools darker and less watery; no blood. 10th. Improving; motions more consistent. 16th. Diarrhœa ceased. Discharged.

Case XIII.—E. H., male, aged 1 year and 8 months, from a court in George Street, Birmingham, which is said to be a medium sized street, open at the rear, in a healthy locality. Rooms situated three stories high, two in number. Child in kitchen by day, and at night sleeps in a room with four other persons. Walls and floor said to be dry. Child not much out of doors. Two previous children have died of "bowel complaint." Father has been subject to disordered bowels. Has been sickly since birth, and has suffered from bronchitis. Dentition commenced at 5 months. Has now nearly all its teeth. Began to walk at 13 months. At times cheerful, at other times apathetic, Suckled up to 15 months. Fed on bread and tea, small quantities of milk and meat very occasionally. Has barely had sufficient nourishment. Mother states that the bowels began to be relaxed about 4 months ago, that this came on suddenly, but she is unable to define the time, that it was not associated with vomiting, but that there were remissions. Admitted to hospital September 11, 1882. Head noticed to be large and of triangular shape. Child is stated to have had convulsive movements, although none have been noticed since admission. Sleeps well. Chest small and ill-covered with muscle. Respirations natural, coughs a little, no audible râle. Abdomen full, movements regular. Walls rather tense, no indications of tenderness, appetite good, does not vomit. Stools stated by mother to be six or seven a day, but had only two motions after admission. They are said to have been watery, green, containing slime and blood, and accompanied by straining. September 12. Had three motions yesterday without blood or straining; 16th, no marked change; 20th, better, looks livelier, and appears stronger, motions free from blood or slime and less frequent; 23rd, able to get out of bed. Sleeps well, appetite good, and has one motion a day on an average. October 1. Bowels moved four times yesterday. October 2. Had only one motion yesterday, stools yellow, not very watery but offensive. The stools having become more consistent and healthy looking, discharged on October 7.

Case XIV.—F. B., female, aged 1 year and 7 months, from Lancaster Street, Birmingham; house said to be in a healthy locality, of two stories, consisting of one room each; ground floor paved with brick, and said not to be damp. Child spends day in ground floor room, and at night sleeps with three others of the family upstairs. Taken out only for a quarter to half an hour daily. Had always fair health with the exception of whooping-cough last winter, and chicken-pox (the mother states) 3 weeks ago. Dentition commenced at 5 months. Began to walk at 15 months. Habitually cheerful. Never had thrush. Suckled since birth, and not yet weaned, but has always been fed in addition on milk, at times with bread. Never used a bottle. Seems to have had enough food. The present illness commenced on August 12 with vomiting, which only lasted a short time, and was almost immediately followed by diarrhœa, for which a chemist was consulted, but as the child got no better she was brought to the hospital. The chicken-pox was succeeded by a larger number of purple spots all over the body, which were obvious on admission at 6 p.m. August 26, 1882. At that time the child appeared fairly well nourished; all her teeth were cut, and there were no indications of exhaustion. Pulse 112, temperature 37° C. Slight depression of anterior fontanelle; posterior closed. Face bright and not particularly pale. No convulsions; sleeps well. Respirations 40; no cough; breath sounds normal. Slight bleeding from nose and mouth. Abdomen full, soft; no indication of tenderness; movements normal; no vomiting, and takes food well. Has four or five stools daily on an average, of yellow colour, watery, and containing blood and slime. August 28. Motions still contain a little blood. August 30. Better, stools yellow and free from blood, reduced to two per diem. Purpuric spots looking duller. The child went on improving, and on September 10 the report is that she was gaining strength and able to get out of bed. But on 15th, the stools during the preceeding three days having numbered from three to five daily, she had seven stools green and watery; she had eight on the 16th, five on the 17th, four on the 18th, six on the 19th, five on the 20th, three on the 21st, and four on the 22nd, after which they became one, two, or three only daily, and more consistent. She was discharged as recovered on October 9.

From these patients (Cases VII., IX., X., XI., XII., XIII., and XIV.), and from four other patients suffering from the prevalent summer diarrhœa, the records of whose

Causation of "Diarrhœa," by Dr. Ballard.

illnesses where not forwarded to me, although their names were mentioned, samples of blood in sealed capillary tubes were on various occasions forwarded to Dr. Klein for examination in aid of the inquiry; but, unfortunately and contrary to my instructions and request, in all the instances several days were allowed to elapse between the date of taking the blood and that of transmission, and in one instance the date on which the blood was taken was not stated when the tubes were sent. This detracts from the value attaching to Dr. Klein's careful investigation of the specimens. Thus—

Blood from Case IX. was not received by Dr. Klein until August 10, 1881, the child having died on August 3. [Several other samples of diarrhœal blood from other patients not named were sent with this sample.]

Blood from G. P.,* from Case VII., and from C. S. was received on August 7, 1882; the date of taking it not mentioned.

Blood from E. E.
„ Case X.
„ E. McD.
„ Case XI.
} stated to have been all taken on August 25 but not received until September 1.

Blood from Case XIV. taken on September 14 -
„ E. E. (further specimens) taken on - September 10 and September 17 -
„ Case XI. (further specimens) taken on September 10 and September 14 -
„ Case XII. taken on September 8 -
„ Case XIII. taken September 14 -
} was not received until Sept. 19.

The following is Dr. Klein's report upon the specimens sent thus late:

"A. Case IX.—In this blood were found micrococci, mostly in dumb-bells, but some isolated. None of the other specimens sent at the same time contained anything abnormal.

G. P. Case VII. and C. S., received August 7.—Micrococci were seen in only one specimen, that from C. S.

The samples received on September 1.:

E. E.—No distinct evidence of micrococci.

Case X.—No distinct evidence of micrococci, although there is something which looks like it.

Case XI.—Distinct micrococci.

E. McD.—No distinct evidence of micrococci, although there is something which looks like it.

The samples received September 19.—No evidence of micrococci in any of these samples.

B. The following cultivation experiments were made:

a. Inoculated sterile neutral pork-broth in test tubes in a manner that precludes accidental contamination, with the blood of—

(1.) C. S. and (2.) of Case VII.

These inoculations were carried out immediately on the receipt of the samples on August 8. After the inoculations the test tubes were placed in incubator at a temperature of 22° C.

Results.—1. C. S.—After one week there was a copious crop of beautiful micrococcus in the test tube, the fluid being hereby rendered of course turbid.

2. Case VII.—This remained perfectly limpid and no growth appeared until September 2. It was then exposed to a higher temperature, viz., 32° C. On September 6, *i.e.*, after four days, the fluid was turbid and full of micrococci of somewhat larger size than that inoculated with the blood of C. S.

b. On September 1, inoculated similar sterile pork-broth to that used above with the blood of—

(3.) Case X. and (4.) of E. McD.

The test tubes were placed in the incubator and exposed herein to a temperature of 32° C.

---

* I give initials in the instances where no record of the case was furnished to me.

Results.—In both cases a copious growth of micrococci was visible on September 4. In the fresh blood the micrococci were too few and not distinct, and hence we could not with certainty judge of their existence; but now it appears that there must have been micrococci in both samples when I received them. Especially in the case of E. McD. there were exquisite chains of micrococci beside single ones and dumb-bells.

C. The following inoculation experiments on animals were made:

1. With micrococcus cultivation obtained from the blood of C. S., inoculated subcutaneously two guinea-pigs on August 15.
2. With blood of E. E. from sealed capillary tube inoculated one guinea-pig on September 1.
3. With blood of Case XI. from sealed capillary tube inoculated two guinea-pigs on September 1.
4. On September 1. re-inoculated one of the guinea-pigs which had been inoculated with cultivated micrococcus on August 15, and also one new guinea-pig.
5. With micrococcus culture obtained with the blood of Case VII. inoculated one rabbit on September 4.
6. With the micrococcus culture obtained with the blood of E. McD. inoculated one guinea-pig on September 4.

Results.—In no single instance did the above animals show any alteration; their temperature was taken twice daily, and it remained always normal. The animals fed well, were lively, and all their functions were normal.

E. K."

Microscopical Examination of Diarrhœal Stools.

The following is Dr. Klein's report on this subject—

"In the course of the year 1882 I examined microscopically the stools of a considerable number of children suffering from chronic diarrhœa, *e.g.*, associated with chronic peritonitis, tuberculosis intestinalis, scrofula, and various other wasting (not ascertained) diseases, and I found in them various kinds of bacilli and various kinds of micrococci. Of these the following may be specially mentioned:—

a. A mobile bacillus spore-bearing, which proved to be bacillus amylobacter.

b. A bacillus, mobile, but shorter than the former, and in its size and occurrence as dumb-bells resembling bacterium termo.

c. A thin non-mobile bacillus, in some examples containing two or four granules: it grows in clumps and corresponds to the bacillus of Escherich.

d. Various forms of micrococci differing from one another in size and arrangement: while some formed exquisite chains, others formed more or less sarcina-like groups, while still others were aggregated in clumps or zooglœa." E. K.

The following series of cases are abstracts from Dr. Ashby's case-books, and are introduced mainly on account of the elaborate *temperature charts* which accompany most of them:—[For these *see* end of Appendix.]

Case XV. (Case-Book Ref. No. 488 S.), E. D., female, aged 4 years 9 months, admitted Oct. 4, 1880.—Had diarrhœa about a month ago, and is not thoroughly well from it yet, getting much thinner. Began to swell in face on Friday; in legs and hands on Saturday. Passes urine. A very poorly nourished child and very anæmic. Tongue clean; gums spongy. Nothing abnormal observed in the chest or abdomen on physical examination. Slight œdema of right arm. Both feet and legs a little œdematous. Pulse could not be counted at the wrist. Oct. 5. Bowels acted twice in night, very loosely. Child is still in a state of collapse. Pulse 104, but cannot be felt at the wrist. Resp. 20. Oct. 6. Bowels opened seven times in 24 hours. Pulse 124, can just be felt at wrist now. Oct. 7. Pulse 110. Resp. 24. Bowels opened seven times in 24 hours. Oct. 8. Pulse 110, very small. More œdema of arm (left) and legs. Bowels opened eight times in 24 hours. Oct 9. Diarrhœa worse. Found to have vaginitis. Oct. 10. Pulse 100. Resp. 24. Oct. 12. The child seems worse this morning. Pulse, can hardly be felt at wrist, 120. Resps. 28. Bowels opened six times. Oct. 13. Bowels opened five times in 24 hours. Pulse 120, very feeble. Œdema of legs. Oct. 14, 10 p.m. Pulse very feeble. Oct. 15. Bowels opened six times in 24 hours; stools a better colour. Pulse hardly to be felt. Oct 16. More œdema. Pulse very feeble indeed;

Causation of "Diarrhœa," by Dr. Ballard.

hardly to be felt at wrist. Child is very drowsy. Bowels opened six times, passes all urine under her. Oct. 17. Bowels opened seven times. Pulse 112. Œdema the same. Oct. 18. Bowels opened six times. Radial pulse cannot be felt. Tongue very dry. Died at 10.30 p.m.

Case XVI. (Case Book, Ref. No. 436 S.) M. L. Female, aged 10 months, admitted 4th September 1880.—Was quite well 3 weeks ago and could eat and drink anything. A fortnight ago child began to have diarrhœa and has it still, and is wasting away. It has had medicine all the time. It is now purged 3 or 4 times a day, motions green. A very poorly nourished child. There has evidently been rapid wasting. No teeth. Nothing amiss discoverable on physical examination of chest or abdomen. A good deal of redness about the pudenda. Pulse 112. Sept. 5. Bowels opened 4 times since 5 p.m. yesterday; stools pasty, containing a good deal of undigested milk and bile. The child looks worse. Pulse 126, very small. Sept. 6. Bowels opened 5 times in 24 hours, same sort of motions; vomited once. Pulse 160. Looks worse. Sept. 7. Pulse 160, very feeble. Bowels opened 7 times in 24 hours; same sort of motions. On the whole child is worse. Sept. 8. Bowels opened 11 times in 24 hours. Pulse 140, very small. Sept. 9. Bowels opened 6 times in 24 hours only. Has had some milk since yesterday afternoon and only vomited once. Pulse 140. Has lost 10 oz. in weight in 2 days. Sept. 10. The child is evidently much worse. Not so much diarrhœa. Pulse 136. In this way the child went on getting worse, the motions varying from 6 to 13 daily, the pulse from 114 to 140 and feeble until the 22nd, when some pemphigus-like blebs appeared on the back and she died at 5.30 p.m.

Case XVII. (Case Book, Ref. No. 443 S.) J. N. Male, aged 3 years 9 months, admitted 7th September 1880.—Has been ill for last 2 months. He was purged for about a fortnight at first, was then taken to the hospital and soon got the diarrhœa stopped. Child is now wasting away and refuses food. No diarrhœa now. No cough. A poorly nourished child. Long eyelashes. Lips dry and cracked, rather blue. Chest resonant all over. Some rhonchus over the left lung in the lateral region. Large crepitation and rhonchus, now and then at the right apex. Pulse 104. Resps. 28. Milk diet. Sept. 8. Bowels opened twice since admission, not relaxed. Pulse 108. Sept. 9. Bowels opened 5 times. Pulse 112. Takes its food fairly well. Sept. 10. Bowels opened 4 times in 24 hours. Pulse 120. Sept. 11. Diarrhœa much better. Bowels not opened during the night. Takes food well. Sept. 12. Bowels opened 3 times in 24 hours. Sept. 13. Bowels opened 5 times in 24 hours. Sept. 16. Diarrhœa about the same, 4 times in 24 hours. Sept. 21. Hardly any diarrhœa now. Sept. 24. To get up. Discharged Oct. 3.

Case XVIII. (Case Book, Ref. No. 448 L.) M. R. Female, aged 1 year and 9 months, admitted 8th September 1880. A thoroughly rickety child. Forehead high and broad, fontanelles not closed. Back noticed growing out for 3–4 months past. Child can sit up for a long time without any complaint. When 6 months old, perambulator turned over, and this is the only accident child has met with. Weaned at 6 months of age and fed with bottle till 12 months old, since then has had whatever has been going. Teething commenced late and is still in progress. Sweats much of a night, especially about the head. Has slight cough. Bowels relaxed. Last week child has been more thirsty, and fretful on being disturbed. Appears to be in pain. Sept. 9. Chest resonant all over, crepitation over the right lung at the back. The spine is very slightly curved, the most prominent vertebra being the last dorsal. It can be straightened when the child lies on its belly and is pulled out. Pulse 104, feeble. Sept. 12. A good deal of diarrhœa yesterday. Sept. 13. Bowels opened 8 times yesterday. Sept. 16. Bowels opened 4 times in 24 hours. Vomits now and then. Sept. 17. Bowels opened 6 times. Sept. 21. Bowels opened twice in 24 hours. Sept. 25. Going on well. Oct. 1. Still a little diarrhœa. Oct. 12. Diarrhœa nearly stopped now. Sept. 24. No diarrhœa. Sent out much improved.

Case XIX. (Case Book, Ref. No. 457 S.). W. C. Male, aged 1 year 8 months, admitted September 13, 1880.—Has been wasting and had diarrhœa for the last 3 months. He has got much worse the last fortnight. No cough. Vomited last day or two. Child fairly nourished. Anterior fontanelle not closed. No physical evidence of disease in the chest. Abdomen rather full. Pulse 112. Temp. 98°. Resps. 24. Tongue clean. Sept. 15. No diarrhœa the last 24 hours. The further progress of the diarrhœa is recorded on the chart. Nov. 10. Has been on peptonised milk gruel for the last month, and during this time he has had very little diarrhœa. Runs about during the day. Is now to have half his food not peptonised. Nov. 13.

Bowels only opened once yesterday. To have no peptonised milk now. Dec. 1. Sent home quite well. No return of diarrhœa after being on ordinary food for about a fortnight.

Case XX. (Case Book, Ref. No. 510 L.). R. G. Male, aged 15 months, admitted October 11, 1880.—He began to waste 3 months ago; had diarrhœa in the first instance, but that has stopped now. He is, however, getting much thinner. Has been allowed to eat anything. A poorly nourished child. Chest resonant at both bases. A little crepitation at both bases. Air enters freely into rest of chest. Abdomen full. Nov. 5. Child much fatter, still very pale. Nov. 13. Some little diarrhœa yesterday and this morning. Nov. 25. Still some diarrhœa. Progress of diarrhœa recorded on the chart. Dec. 21. Pulse 160. Resps. 40. Chest clear. 11.30 p.m. Pulse 160. Resps. 40. No rash. Bowels opened 5 times. Dec. 22. Pulse 88. Resps. 28. Bowels opened once in the night. Seems all right. Discharged Jan. 5, 1881.

Case XXI. Manchester Children's Hospital (Case Book, No. 453 W.). M. A. S. Female, aged 1½ years, admitted July 12, 1886.—Family history. Father and mother healthy. Other child strong. Previous history. Always strong till 4 weeks ago. Weaned 2 months ago. Fed on anything. Walked at 10 months, and has 8 teeth. History of present illness. Has had diarrhœa 4 weeks. No vomiting. Motions slimy, offensive, very frequently passed at first. 3 and 4 a day now; quite watery, yellow, offensive. No evidence of pain. On admission. Wasted, very pale; skin inelastic, dry, rough, and hot. Breathing rapid, shallow, with some recession at bases laterally. Abdomen very prominent, not tense. Much gurgling on palpitation. Spleen and liver not enlarged. No sign of pain or tenderness. Chest small. Dulness at left base, behind. Breath sounds very weak, bronchial with râles. Elsewhere breath sounds harsh, with râles. Right base, breath sounds very weak. Râles all over right lung. Child died 8 p.m. same evening. [No temp. chart.]

Autopsy.—Nutrition. Emaciation not extreme. Abdomen distended with air. Thoracic glands not enlarged. Pleuræ normal. Bronchi injected and mucous secretion increased. Lower half of inferior lobe of left lung dark on surface, depressed, solid, catarrhal pneumonia on section; upper lobe emphysematous. Right upper lobe emphysematous, lower lobe gorged, semi-pneumonic. Heart normal. Abdomen: peritoneum normal. Lymphatic glands pale, not enlarged. Stomach softened. Intestinal contents fluid with yellow flocculi. Jejunum bile stained, also patches of congestion, mucous membrane gelatinous, and excess of mucus. Ileum shows much congestion in places, vivid pink, especially Peyer's patches, excess of mucus and gelatinous. Cæcum, much congestion. Colon, congestion of folds of mucous membrane, the latter thickened, excess of mucus. Similar changes in rectum. Liver pale and enlarged. Kidneys pale, especially cortex. Spleen firm.

Case XXII. Manchester Children's Hospital (Case Book, No. 623 W.). J. W. F. Male, aged 12 months, admitted Sept. 20, 1886. Family history. Father and other children weakly. Five children dead from bronchitis and inflammation of the bowels. Previous history healthy. Weaned at 11 months. History of present illness. Ailing and wasting 1 month. Diarrhœa has lasted 1 month, 4 or 5 times daily. Appetite ravenous, takes meat freely. Vomiting three or four times daily. Getting worse daily. On admission very much emaciated, wizened-looking child, sunken eyes, ribs very visible, scapulæ protruding. Bowels said to be open 3 times daily. Chest. Resonant back and front, sounds mostly dry, occasional rhonchus at bases. Breath sounds puerile or tubular in character (? scattered consolidations). Heart sounds normal but extremely feeble; pulse often hardly felt at wrist, and hands always cold. Abdomen somewhat distended, veins prominent, dark, no tumour. Liver some ¾ in. below ribs. No œdema anywhere. Some oïdium in mouth. Urine not obtained. Sept. 22. No improvement since admission, extremities cold, child always crying. Bowels purged 3 times, with excess of curd in stools; very little bile present. Mouth cleaned by boracic acid, but tongue still very red, almost raw looking. P.m. Very cold, almost in a collapsed condition, eyes turned up, pulse extremely feeble. Sept. 25th. Died.

Autopsy.—Weight 8½ lbs., heart 1¼ ozs., lungs 8½ ozs., liver 9 ozs., spleen ½ oz., kidneys 2 ozs. Body extremely emaciated. Rigor mortis present. Eyes sunken. Ricketty thorax, ribs very prominent. Abdomen distended, dark. Thoracic glands not enlarged. Lungs and pleura. No adhesion. Apices collapsed, but contained a small quantity of air, and floated. Both lungs deeply congested, red, sank in water

Causation of "Diarrhœa," by Dr. Ballard.

Heart normal. Lymphatic glands enlarged, not caseous. Stomach congested; patches of extravasation. Intestines wasted. Small intestine injected in patches, and contracted to size of quill for couple of feet; in two or three places very thin. Large intestine more injected, no ulceration. Liver fatty. Kidneys apparently healthy (but no microscopic examination made). Spleen congested.

Case XXIII.—*Infantile Diarrhœa, Clot in Longitudinal Sinus.*—Manchester Children's Hospital (Case Book No. L. 602). Abstract by Dr. Ashby.—William H., aged 7 months, admitted Sept. 10, 1886. No history of phthisis; always in good health previously; ill for 3 weeks, passing on an average 12 stools daily; occasional vomiting; rapid wasting; has been fed on milk and barley water. On admission, Sept. 10, very ill; collapsed; vomits all food; stools green and unhealthy-looking, chiefly undigested milk; pupils contracted greatly; temp. 99° and rising. Later, rejects enemata; collapse extreme; brandy injected subcutaneously. Sept. 11th. Temp. 100°, rising to 103° before death; ? meningitis setting in; head continually rolled from side to side; pupils contracted; left external strabismus, not constant; no convulsions; taking milk better; no vomiting; six stools passed yesterday, none during this morning. Died at 8 p.m. [No temp. chart.]

Autopsy.—Sept. 13. Rigor mortis absent; no œdema; body still fairly nourished; thoracic glands normal; lungs partially collapsed at bases; some emphysema of upper lobes; no pneumonia; heart normal; abdomen, peritoneum and glands normal; stomach contracted, some streaky hæmorrhages; much mucus; small intestine, mucous membrane and especially Peyer's patches injected; large intestine, injection of summits of folds and much irregular, patchy, superficial ulceration; liver and kidneys pale; spleen congested, apparently some hæmorrhage into it; brain, no meningitis; subarachnoid fluid in excess; lateral sinuses distended; veins of surface distended; longitudinal sinus filled with colourless (? antemortem) clot.

Case XXIV. *Infantile Diarhœa.*—Manchester Children's Hospital (Case Book, No. L. 88). Abstract by Dr. Ashby.—James Q., aged 1½ years, admitted Feb. 10, 1886. No history of consumption; child backward, but always healthy; had measles six months ago and recovered well; had slight sore throat two months ago (not scarlet fever); œdema noticed for past five weeks; some excoriation lately; urine scanty. On admission, Feb. 10, very fat, flabby, anæmic child; some œdema of legs; skin dry and excoriated about perineum and thighs, with patches of desquamation on thighs; abdomen rather retracted; liver felt beneath ribs; spleen not felt; temp. subnormal; no albumen in urine. Feb. 15. No better; stools liquid and very foul, about four passed daily; takes but little food. March 2. More œdema; lungs becoming œdematous; stools still foul and liquid; died at night. For a day or two at a time the child improved somewhat. [No temp. chart.]

Autopsy.—March 3. Rigor mortis slight; nutrition very poor; some ascites; œdema general. Lungs, lower lobes œdematous and partially collapsed; thoracic glands healthy. Heart, slight excess of pericardial fluid; right cavities distended with black, fluid blood; some fluid blood also in left side; valves normal; walls very flabby. Abdomen, parietal peritoneum normal; six ounces of amber-coloured fluid; mesentery dotted over with small extravasations of blood; swollen and congested where attached to large intestine and last foot of small intestine. Stomach and most of small intestine natural; lowest 18 inches of small intestine and whole of large intestine deeply congested; mucous membrane œdematous, thick and velvety; no ulceration; solitary follicles swollen. Liver, large, soft, pale, and mottled; lobules distinct, ? fatty. Kidneys, small and shrunken; capsules a little adherent; cortex not obviously wasted. Spleen natural.

I have given an abstract of this case because Dr. Ashby, who is a most careful observer, and whose opinion deserves every consideration, appears to have satisfied himself that the slight sore throat mentioned above was not scarlatinal, and, I presume by the customary method of exclusion, arrived at the diagnosis with which the record of the case is headed. Nevertheless it looks very much as if the sore throat had been the starting place of the kidney mischief. Unfortunately the date of the commencement of the diarrhœa is not mentioned.

Case XXV. Manchester Children's Hospital (Case Book, Ref. No. U. 561). E.B. Female, aged 6 months, admitted August 23, 1886. *Acute Diarrhœa and Meningitis.*—Family history, good. Has always been delicate. Has had diarrhœa and vomiting for the last 2 months, for which has been attending the Infirmary. On admission. Puny, ill-nourished child. Skin loose on bones. Heart and lungs normal. Diarrhœa slight in

quantity twice daily, chiefly undigested milk curds. Abdomen somewhat distended, no lumps to be felt. Takes food well. Aug. 26. Bowels open, 3, 5, and 7 times daily since admission, same in character. Aug. 27. Last night at 12 p.m. temperature ran up to 105, and has continued above 105 until 10 a.m., at 11 went to 106. Condition of child much same, vomited once this morning. No rash. No signs of pneumonia. No sore throat. Noon. After sponging temp. fell to 101°. 4 p.m. Temp. went up to 105·8 at 3 p.m., second sponging ordered, which brought temp. down to 102. At 4 p.m. child in collapsed condition, almost pulseless. Eyes apparently insensible to light, pupils occasionally dilated and contracted, and squinting frequent. No definite convulsions of arms or legs. 6 p.m. Temp. rose again to 105·2°. Child almost moribund, gasping for breath. Pulse very feeble. Eyes rolled about, alternately contracting and dilating. One definite convulsion, lasting ½ minute, seen affecting both arms and legs. Gradually sank, and died about 9.30.

Autopsy, 23 hours after death. No rigor mortis. *Abdomen*, glands not enlarged, no tubercle. Intestines inflated. Patches of inflammation scattered throughout, no ulceration. Duodenum intensely congested, and recent intussusception, about 1 in., easily yielding to traction; two other slight intussusceptions in small intestine, and one more at the cæcal valve. Large intestine also inflamed in patches. *Liver* hard, somewhat congested. *Kidneys* normal. *Spleen* congested. *Lungs*, some congestion at both bases, otherwise normal. *Heart* normal. *Brain*, exterior of both hemispheres somewhat congested. Brain soft and rather lacerated in extraction. One spot of inflammatory lymph near optic commissures. No lymph or tubercle in fissures.

APPENDIX B.

Report upon a Chemical Examination of the Excreta of Diarrhœa Cases: By Dr. Theodore Cash.

In the summer of 1885 I conducted, under the Board's instructions, an inquiry into the character of the excretions in infantile diarrhœa, chiefly with regard to their contained nitrogen. The results arrived at are embodied in the following report.

Unfortunately for the completeness of the inquiry, but three cases presented themselves for observation; they occurred late in the season, and were of prolonged duration. One advantage, however, resulting from this fact was, that the course of the affection could be studied from day to day coincidently with the examination of the excreta and of the urine. It was highly desirable, in an inquiry of this nature, that a close approximation to the total amount of fæces and urine, the chief channels for nitrogenous excretions, should be arrived at, as well as that no contamination of the one by the other should occur during the collection. The difficulty of this collection is by no means a small one, and entails an amount of laborious care, which can scarcely be realised by those who have not themselves attempted to accomplish it. In order to secure a large proportion of the alvine discharge a special arrangement became needful. This consisted of a sacculated sheet of gutta-percha, capable of adjustment under the customary cloth in order to catch and retain the—sometimes very copious—evacuations which are passed in the course of the disease. In the case of female babies the absolute separation of urine and fæces is peculiarly difficult, as, from the conformation of the perineum and the fact that defæcation and micturition usually occur at the same time, contamination is very apt to occur. With older children the difficulty is not so great, and in the case of boys of any age the contamination may be prevented by a special arrangement which is kept constantly in position for the collection of the urine.

In all cases the greatest cleanliness was practised; the collected ejecta were at once transferred to glass bottles which had been previously scalded, and these were securely closed, labelled, and forwarded to the laboratory for examination. Accompanying the sample I received a report of the progress of the case, and a statement of the exact quantity and nature of the nourishment administered. Examination of the samples was proceeded with immediately upon their arrival. In almost every instance the sample representing a given day was a mixture of two or more evacuations of that day, and the same may be said of the specimens of urine which it was found practicable to collect The parents of the child P. (Case I.), and a special nurse who attended

Causation of "Diarrhœa," by Dr. Ballard.

exclusively upon the other two cases, L. (2.) and M. (3.) carried out the directions with which they had been furnished.

A short clinical history of the cases under consideration will now be given, and subsequently the method of examination and the results arrived at will be discussed.

Infantile Diarrhœa.

Case I. (Leicester). E. P., aged 6 months. Seen by Dr. Klein and myself in company with Dr. Buck, August 26, 1885.

History.—Father and mother, who are intelligent people, state that the child has been hitherto healthy except for having had the "thrush" when three weeks old.

Three days ago (August 23) evacuations became frequent, slimy, mucoid, and green, with occasional bloody patches. A very large quantity is said to have been passed. Thus, the mother stated that on the 24th the child was "very often purged," on the 25th more than 12 times. On the 26th, 12 times up till 4 o'clock when we saw the child. On the 24th very small quantities of urine passed; 25th ditto. 26th up to 6 o'clock only said to have micturated once.

Present Condition and Surroundings.—The child is large and well developed for age, is still on breast. Looks sunk about the face, but from time to time is more lively and notices surroundings; is restless and frequently cries out. Mother states that she has had much care and anxiety on account of business difficulties; she has plenty of milk, and her own health is not amiss. Father a boot manufacturer, living-room is small and close. People as cleanly as circumstances permit.

There is slight abdominal tension without marked tenderness on pressure. Lips not markedly dry. No sordes or ulceration of gums. No fœtor of breath. Stools as already described.

Case II. S. L. (Leicester), aged 15 months.

History.—Admitted into Leicester Infirmary, August 27, 1885. Mother (a dull badly clad woman) states that she has three more children, all of whom are healthy. A fourth however died of "consumption of bowels" when nine month old. Till three weeks ago she nursed the child S. Has always herself been healthy. Five weeks ago the milkman brought a supply of milk from a fresh source. The child at once began purging violently. The succeeding day both vomited and was purged. Matter purged and vomited was "grass green" with a very unpleasant odour. This state of things after lasting a time abated. The child at times was up, but never well enough to wish to play; was thin and weak. Six days ago (August 21) purging recommenced actively. Sickness from time to time. Belly swollen and hard. Child frequently screamed. No sweating. Always feels cold "like ice" up to knees.

Present Condition.—Is tall for age, limbs very thin and wasted. Face thin, eyes sunk, expression anxious. Now and then utters a wailing distressed cry; is restless and wearied. Belly slightly tense, decidedly tympanitic. Thighs slightly excoriated. Pulse 120, compressible, weak. Lips and mouth rather dry, no aphthæ. Tongue dry with slight moist fur. Has two central lower incisors, four upper ditto, and is cutting three back teeth. When purged has much rumbling and voids much flatus. The breath is not fœtid, but stools which are passed are peculiarly offensive.

August 27. Has purged twice to-day (up to 2 p.m.). Sick last night but not this morning.

Case III. C. M., Leicester, aged four months.

History.—Admitted to Leicester Infirmary, August 27, 1885. Mother states that when the child was 12 weeks old it was ill with the same complaint for three days, but not so much as at present. Has not been vaccinated (medical postponement).

On 21st instant (six days ago) had a threatening of diarrhœa, but this passed off after administration of castor oil. On the 24th diarrhœa returned. Purged every few minutes. Smell offensive. Stool thin and yellowish "like water." Vomiting frequent. Mother works at woollen sorting. This child is still on the breast, though the woman states the milk is poor. She has only been in the habit of nursing the other children for one month. She is "out of sorts" herself. Suckles child a little now and then, and the cow's milk administered between times. Other children never ill in this way before.

Present Condition.—Child large, well nourished, plump. Complexion pasty, but is not sunk about the face. Belly swelled and slightly tympanitic on percussion, tenderness

seems general. Pulse 144, small, thready. Child emits a cry very frequently, distressed expression at the same time. Rubs gums with hands, but no tooth tension or excoriation apparent. No aphthæ or thrush. No fœtor of breath. There appears to be pain on evacuation of bowels and on micturition.

Method of Examination.

Very careful and laborious investigations by Ritthausen, Segen, Nowak, Gunther, and many others have been made with the view of determining by what process the most exact estimation of the total nitrogen contained in azotised bodies, may be effected. The two methods which have yielded the most reliable results in the examination of fæces have been those of Dumas and Will-Varrentrapp, and their modifications. Control experiments conducted with substances of known elementary composition, Guandin and Casein,* have shown that when the azotised bodies present have been brought in a state of exceedingly fine subdivision into intimate mixture with soda-lime, and have then been subjected to complete combustion, all the nitrogen is liberated as ammonia, and the total result is identical with or but very little less than, that obtained by Dumas' oxide of copper method.

If, however, the combustion be incomplete owing for one cause to insufficiently fine division of the substance, or to the imperfect emptying of the combustion tube after the evolution of nitrogen is over, the result will manifestly be lower than it ought to be according to Dumas' method.

If certain precautions, however, be adopted (speaking of the examination of fæces) I can add my testimony to those who have found that the discrepancy of result between the two methods is so insignificant as to be practically negligible.

The conditions to be carefully attended to in the packing and subsequent combustion by the soda-lime method are the following:

1. The reduction of the substance to a state of extremely fine subdivision and intimate mixture with powdered soda-lime. This is best accomplished in a marble mortar. The soda-lime must have been thoroughly heated previously.
2. A sufficient mass of soda-lime in the combustion tube both finely divided (5 c.m. in hinder end of tube, 12 c.m. mixed with the nitrogenous body, and in front of this 6 c.m. of soda-lime alone) and coarse, 5 c.m. in the anterior part of the tube.
3. A long plug of asbestos in front of the coarse layer of soda-lime, and in contact anteriorly with the cork which is perforated for the passage of the horizontal limb of the nitrogen bulb.

(1.) As regards the combustion, it is most important that the anterior (unmixed) layer of soda-lime shall be brought to a red heat before the flame is applied to the hinder part of the tube containing the nitrogenous mixture, or to the soda-lime immediately behind, and that this high temperature shall be maintained during the heating of the back parts of the tube, otherwise a very extensive and annoying accumulation of bodies having an odour of pyridin is apt to be found in the nitrogen bulb.

From control experiments I have found that the nitrogen estimated as ammonia was exactly the same for equal weights of a given body, whether sugar was introduced into the tube either in contact with the nitrogenous substance, or in the finely divided soda-lime at the hinder end of the tube. I therefore did not employ it in the greater part of the estimations, as the presence of its ash might possibly lead to a slight loss from its retention of some of the nitrogen which would otherwise have been evolved.

(2.) The amount of dried fæces I found it most convenient to employ in each combustion was ·05 grm.

The amount of ammonia liberated was estimated by charging the nitrogen bulb with 10 to 20 c.c. of a decinormal solution of sulphuric acid, and by subsequently titrating this with a decinormal solution of potash. From the data thus obtained the total nitrogen could be readily estimated.

As an index of neutralisation a little phenolphthalin in powder was placed in the porcelain capsule together with the acid from the bulb, and into this the potash solution was discharged from a finely calibrated burette. Of this index one can scarcely speak too highly, not only does it show clearly when there is a close approach to neutralisation, but the instant that this has resulted, the fact is so easily recognised that two observers will almost certainly agree within one drop of a decinormal solution for the same estimation.

* Makris. Liebig's Annal. d. Chim., Bd. 184.

Causation of "Diarrhœa," by Dr. Ballard.

The method employed in preparing the fæces for combustion is highly important. To deal with the fresh material is scarcely advisable, as it is difficult to obtain its satisfactory admixture with the soda-lime, and to carry on the subsequent manipulation without losses; again the introduction of a sufficient quantity of the mass necessary for the production of a recognisable amount of ammonia, renders the combustion more liable to failure from cracking of the tube, though with care this danger is greatly lessened. It is therefore usually advisable to evaporate to dryness in the first instance, and in doing so the loss of nitrogen must be guarded against, otherwise its total estimation will be apt to be understated. The most usual proceeding, is to render the fresh mass acid by means of phosphoric acid, in order to "fix" the ammonia which would otherwise become free and so escape estimation.

In spite of this precaution, however, a certain loss does take place, and to rectify the error thereby introduced into the subsequent calculation, an approximate addition must be made.

In order to obtain an estimation as nearly absolute as possible it was decided to evaporate the fresh mass in a stream of dry heated air, and to pass the escaping gases through deci-normal acid solution contained in a nitrogen bulb. This was accomplished by the following means:—

A thick walled combustion tube having a length of 14 ins. and an internal diameter of 1 in. was passed through the ends of a cylindrical iron box having a length of 11 ins. and a breadth of 5 ins. The ends of this cylinder were provided centrally with holes to allow of the passage of the glass tube. At its circumference the metal wall of the tube was perforated with a small opening to allow of the passage of a thermometer. The glass tube was provided at both ends with accurately fitting corks, each perforated in its centre for the passage of a glass tube having $\frac{3}{8}$ in. internal diameter. One of these perforated tubes was connected with two Wolff's bottles, each of which was half full of pummice stone, saturated with sulphuric acid in order to dry the entering air and free it of ammonia. The other tube conducted the escaping gases into a pair of nitrogen bulbs which were by their vertical arms connected with an exhaust. As the bulbs were connected by means of U-tubes with exhaust and inner cylinder, it was possible to direct the current of escaping air through one or both at pleasure, and at any stage of the evaporation one of them could be removed in order to determine at what time the largest escape of nitrogen occurred.

Into the central combustion tube, a boat made of platinum foil in which a certain quantity of fresh fæces had been weighed, was introduced; the tube was closed by means of the corks, a rose burner was placed beneath the metal cylinder in order to heat its interior to temperatures ranging from 100° to 110° C., and the exhaust pump was set in gentle action.

After the completion of evaporation, the boat was again weighed together with its contents. The original weight of the boat subtracted from this gave, of course, that of the dried fæces. A portion of the contents of the boat was used for further combustion, and thus the total nitrogen, (*a*) from evaporation, (*b*) from combustion, was obtained.

A daily journal of the cases examined will be found convenient for reference, and I shall therefore introduce it in this place.

Schedule of Cases of Infantile Diarrhœa.

Case.	Date.	Sample.	Fæces. Quantity.	Fæces. Colour.	Fæces. S. Gravity or Weight.	Fæces. Odour.	Fæces. Reaction.	Urine. Colour.	Urine. S. Gravity.	Urine. Reaction.	Urine. Albumen.	Urine. Quantity.	Diet and Condition.
I.	August 27	1	10·5 grammes collected, with loss of more fluid part of stool.	Greenish yellow, with spots of blood throughout substance.	Viscid; tenacious.	Diarrhœaic; very offensive.	Acid - -	- - -	- - -	- - -	- - -	- - -	†Twelve evacuations occurred in 24 hours. Has vomited after medicine. Very small quantities of urine passed.
	„ 28	2	8·5 grammes -	As above, but no trace of blood. Adheres to sides of jar.	„ -	„ -	Strongly acid	- - -	- - -	- - -	- - -	- - -	Four evacuations in 9 hours. Urine passed in very small quantities; could not be collected.
	„ 29*	See foot of page.											
II.	August 28	2	In 24 hours 350 c.c.	Mustard yellow; homogeneous but for little white flocculi distributed throughout.	1023	Pungent fœtid	Faintly alkaline.	Some urine passed with fæces, which are thereby contaminated. Quantity mentioned in report of nurse as "very small." No separate collection.					*Diet.*—12 ozs. of milk, ½ oz. of alcohol mixture. 9 evacuations of the bowels occurred in the 24 hours.
	„ 29	3	In 24 hours 255 c.c.	Orange yellow gum-fluid; flocculi abundant throughout.	1040	Fœtid - -	Alkaline -	Straw colour; turbid.	- - -	Alkaline -	Albuminous -	12 c.c. collected	*Diet.*—11 ozs. of milk, ½ oz. of alcohol mixture. Had 3 evacuations of bowels in 24 hours; micturated 9 times; decidedly better.
	„ 30	4	In 24 hours 136 c.c.	Pale yellow; more adhesive.	- -	- - -	Acid - -	- - -	- - -	- - -	- - -	- - -	*Diet.*—12 ozs. of milk, ½ oz. of alcohol mixture. Had 4 stools in 24 hours.
	„ 31	5	In 24 hours 121 c.c. Some lost.	Pale yellow; many flocculi of 2-3 mm. in diameter.	1023	Less offensive	Neutral -	- Some urine passed with fæces, which are thereby contaminated -					*Diet.*—Same as 30. VIII.
	Sept. 1	6	In 24 hours 260 c.c.	Pale yellow - -	Treacly consistence. 1063	„ -	Acid - -	- - Very little urine passed. Not any collected - -					*Diet.*—1 pint of milk, ½ oz. of alcohol mixture. Bowels more relaxed.
	„ 2	7	In 8 hours* 15 grammes.	Colour and consistence of putty.	- -	Stale cream cheese odour.	Faintly acid -	- - - do.	do.	do.	- -		*Diet.*—As yesterday. Discharged improved.
III.	August 27	1	In 12 hours 105 c.c.	Mustard yellow -	1011	Very fœtid -	Strongly acid	- - -	- - -	- - -	- - -	- - -	*Diet.*—Cow's milk and soda water. Mother nurses 3 or 4 times daily.
	„ 28	2	In 12 hours 16 c.c. collected.	Dark creamy yellow; fine flocculi, otherwise homogeneous.	No blood -	Not as fœtid as on 27th.	Acid - -	Straw yellow; turbid. No deposit.	1009	Acid - -	Alb. - -	In 24 hours, 175 c.c.	*Diet.*—As yesterday, but very sick after mother nursed it.
	„ 28	2*a*	In 12 hours 3 stools. 9·5 c.c. sent.	Grass green mucous -	- - -	Not so offensive.	Strongly acid	Pale straw colour.	- - -	Alkaline -	No albumen -	- - -	Five stools in 24 hours. Very little urine passed.
	„ 29	3	110 c.c. - -	Dark creamy yellow -	1028	Not so fœtid; sour.	Strongly acid	Straw yellow; turbid.	1010	Acid - -	Alb. - -	190 c.c. - -	Is considered to be improving. Had 2 stools.
	„ 30	4	205 c.c. - -	Colour and consistency of custard.	1034	"Addled egg" odour.	Acid - -	Light straw yellow; cloudy.	- - -	Acid - -	Alb. - -	200 c.c. - -	Not so well. Bowels moved 4 times; micturated 4 times.
	„ 31	5	183 c.c. - -	Orange yellow custard-like fluid.	1034	Less obnoxious than yesterday.	Strongly acid	Light straw yellow; turbid.	1014	Strongly acid	Alb. -	50 .c. - -	Bowels moved 8 times; only micturated twice (?), and very little at a time.
	Sept. 1	6	4·5 c.c. quantity collected and sent.	Thick custard consistency.	- -	-	Acid - -	„ -	1015	Slightly alkaline.	Alb. - -	300 -	*Diet.*—Receiving alcohol mixture. As in Case II., mother nursing thrice daily.
	„ 2	7	One evacuation of 20 c.c. before discharge.	Dark yellow, and tenacious.	Flocculi abundant & large.	Curdy - -	Neutral -	„ -	1002	Slightly acid -	Alb. - -	400 - -	Is much better.

* Note.—Child discharged from Infirmary ward without my knowledge. All attempts to obtain a sample of its evacuations after complete recovery were unsuccessful.
† The reports and figures are for 24 hours, except when otherwise stated.

Causation of "Diarrhœa," by Dr. Ballard.

I shall now briefly record the result of the estimations of nitrogen. (I quote only to the fourth place of decimals; the calculations, however, are frequently obtained from the exact estimation.)

Case I.

Sample 1 (This sample consisted of 10·5 c.c.) Of this evaporate 3 grm. After acidulating with phosphoric acid, the dried residue weighs ·532 grm. or 17 per cent. It is a dark bronze resinous looking mass, having a splintery fracture. After combustion of ·05 grm. (Will-Varrentrapp), neutralization of the free sulphuric acid was made with deci-normal ($\frac{N}{10}$) potash solution, phenolphthalin being used as the index. The estimated nitrogen was ·0028 for ·05 grm. dried fæces, or ·056 for 1 grm. (dry), or ·99400 per cent. fresh fæces.

Sample 2 * Evaporate 3 grm. after acidulating. The dried residue of ·530 grm. is a brown resinous mass. This is equal to 17·67 per cent. Combustion of ·05 grm. (W. V.) gives ·0022 grm. of nitrogen, or ·044 per dried grm.

Sample 3. Evaporate 3 grm. of fæces—which are much more liquid than Samples 1 or 2—after addition of phosphoric acid. The residue, which has the same appearance as the earlier samples, amounts to ·245 grm. or 8·17 per cent. Nitrogen in ·05 grm. (W. V.) is ·00154 grm. or ·0308 per 1 grm. of dried fæces, or ·252 per cent. of sample sent.

Case II.

Sample 2. 25 c.c. after acidulation, evaporated to complete dryness on a water bath. The residue is of dark brown colour, having a brittle fracture and a sugary odour. Weight 1·3 grm. Combustion was effected of ·05 grm. of this residue in a soda-lime (W. V.) tube. Neutralization of 5 c.c. ($\frac{N}{10}$) acid solution made with 3·7 c.c. N. 10th alkaline solution. This result is equivalent to ·0364 nitrogen per grm. dried fæces.

Sample 3. Evaporated 1·5 grm. in a platinum boat which had been previously weighed after heating to 110° C. The boat was then placed in the hot air bath already described, and kept heated for three hours at 110° C. The exhausted air was meanwhile drawn slowly through a deci-normal acid solution. Weight after evaporation (boat deducted) 0·097 grm. or 6·46 solid residue per 100 grm. solid fæces. Neutralization for the whole evaporation gave a disappearance of acidity of 0·7 c.c. $\frac{N}{10}$ equal to nearly 0·1 per dry grm. This again would be equal to 0·0647 grm. nitrogen per 100 c.c. moist fæces. An evaporation of a further quantity of fresh fæces having been effected with a like result, three combustions were made in each case, ·05 grm. of the dried residue being employed.

A. A soda-lime tube was prepared without any addition.

B. A second soda-lime tube was prepared, in which pure sugar was added to the layer of lime, behind the nitrogenous mixture.

C. The third tube was prepared of copper oxide in close relationship with the powdered mass of fæces, having magnesite behind and more copper oxide limited by a spiral of pure copper in front of it. (Dumas method.) In this combustion the usual precautions for the absorption of carbonic acid being taken, nitrogen is collected over mercury as it is evolved, and the necessary corrections are subsequently made for temperature and pressure.

The tubes 1 and 2 gave an absolutely identical result; the third gave an inconsiderable variation (increase) in the estimation.

The combustion of the soda-lime tubes gave 0·0448 nitrogen per dried grm. fæces; but to this must be added 0·0099 as the result of the preliminary evaporation, which gives a total of 0·0547 grm. of nitrogen for each grm. of dried fæces.

Sample 4. Preliminary evaporation of 3 grm. fresh fæces gives (4 hours at 110° C. in hot air bath) ·460 solid residue or 15·3 grm. per 100 c.c. This evaporation yielded also a large amount of nitrogen, viz., ·005 per dried grm. Combustion of ·05 grm. of dried fæces yielded N. in the proportion of ·03248 per dried grm. Total, ·0375 per dried grm.

Sample 5. Evaporation in water bath after acidulation gives solid residue in the proportion of 10·2 per cent. c.c. Combusion (W. V.) shows the presence of ·036 grm. nitrogen per grm. dried fæces.

* The more fluid part of the fæces was lost in the collection of the samples 1 and 2.

Sample 6. Preliminary evaporation of 4 grms. fresh fæces (4 hours at 100° C.) in hot air bath yields ·329 grm. residue, or 8·22 per cent. The total nitrogen evolved in combustion (W. V.) as ammonia was, for ·05 grm. (dried), ·00167.

The nitrogen for the first evaporation was, however, ·0035 grm., which, added in proportion to the nitrogen of combustion, gives ·0044 (·0106 + ·0334) per grm. dried fæces.

Sample 7. Preliminary evaporation in platinum boat placed in hot air bath (3 hours at 100° C.) yields 0·65 grm., or 21·97 per cent. dry residue. Neutralization of the contents of the nitrogen bulbs gave ·0043, or ·0066 per grm. dried residue. Combustion of ·04 grm. (W. V.) yielded ·00245, or ·049 nitrogen per grm. dried residue. Total per grm. ·0556.

Case III.

Sample 1. 40 c.c., fresh fæces evaporated to dryness on water bath after acidulation gives 1·805 grm. of a dark brown residue, shellac like in appearance and fracture, of sugary smell and very deliquescent. Combustion (W. V.) of ·05 grm. dried excrement yields ·002 grm. nitrogen, or ·04 per grm.

Sample 2. Acidulated and evaporated on water bath. 5·5 grms. dried residue per 100 c.c. obtained. Combustion of ·05 grm. dried fæces gives ·00168 nitrogen, or ·0336 per dried grm.

Sample 3. Acidulated and evaporated on water bath. 6·5 grms. dried residue per 100 c.c. fresh fæces. Combustion of 0·5 grm. dried fæces gives ·00196, or ·0392 per grm. dried fæces.

Sample 4. Acidulated and evaporated on water bath. 9·2 grm. dried residue per 100 c.c. fresh fæces. Combustion of 0·5 grm. of residue gives ·0028, or ·056 per grm. dried fæces.

Sample 5. Acidulated and evaporated on water bath 5 c.c., leaves ·585 of a solid brown residue having sugary odour. Dry residue per 100 c.c. is 11·7 grm. Combustion of ·05 grm. gives ·00315 nitrogen, or ·0630 per grm.

Sample 6. Evaporate 3·45 grms. in weighed platinum boat introduced into hot air bath for 4 hours at 100° C. The total weight of dried residue is ·338 grm., or 9·8 per 100 c.c. fresh fæces. The total nitrogen evolved as ammonia was ·0031 grm., or ·0091 for 1 grm. dried fæces. Combustion of 0·5 grm. (W. V.) yielded the large result of ·00378, or ·0756 per grm. dried fæces. Total ·0847 per grm. dried fæces.

Sample 7. Evaporated 3 grms., weighed in a platinum boat in the hot air bath for 3 hours 30 minutes at 100° C. Residue ·37183 grm., or 12·39 per cent. The nitrogen evolved in this operation as ammonia is ·00336, or ·00904 per grm. dried fæces. The mass has odour and appearance closely approaching that of normal evaporated fæces of milk-fed infant.

Combustion of ·05 grm. (W.V.) of the dry residue gives ·0033, or ·0658 per grm. Total (·0091 + ·0658) ·0749 per dried grm.

Examination of Urine.

As has been already stated, opportunities for examining the urine in the cases which came under observation were by no means frequent. Only a few samples were obtained, and a further difficulty was experienced in estimating the total amount passed in the 24 hours. From the fact that the nurse's report usually stated that very small quantities only had been passed, as well as from the bulk of those collections which had been successful, it is safe to infer that the co-existing diarrhœa diminished the function of the kidneys to a large extent as regards watery excretion.

From Case I. (female infant) only one sample was obtained. This amounted to 4 c.c. of a turbid fluid, contaminated with fæces and worthless.

From Case II. (likewise a girl) one sample was forwarded for examination. This consisted of 13 c.c. of turbid, somewhat concentrated urine, having a strongly alkaline reaction, and abounding in serum albumen.

The analysis for urea after the albumen had been completely removed gave a percentage of 0·8.

From Case III. a more satisfactory collection was made.

Sample I. This was obtained on the 28th of August, on which date the report stated that micturition occurred five times, very small quantities of urine being voided at each act.

(In this case, that of a male infant, it will be remembered a special provision was used for purposes of collection; this simple apparatus answered its purpose satisfactorily.) The total quantity passed was estimated at 175 c.c. for the 24 hours. This urine was of a pale straw yellow colour, slightly turbid and having an uriniferous odour It was faintly acid in reaction. Specific gravity 1009. A very faint trace of albumen only was present. Urea ·95. Chlorides ·55 per cent.

Sample for 29th August.

Report states that urine passed 6 times. Estimated quantity 190 c.c. Had the same characteristics as last sample. S. gravity 1010. Albumen rather more abundant than yesterday. Urea ·9. Chlorides ·6 per cent.

Sample for 30th August.

Report. Urine voided 8 times. Total quantity passed about 200 c.c. Pale straw colour. No deposit. Distinctly acid. Albumen abundant after its separation. Urea ·9 per cent.

Sample for 31st August.

In 24 hours is reported only to have micturated six times. Very small quantities were passed, total estimated at 150 c.c. This sample has a slightly darker colour than the previous ones; it is cloudy without deposit. Strongly acid. S.G. 1014. Smell not abnormal. Albumen abundant. Urea 1·1. Chlorides ·8 per cent.

Sample 5 for 1st September.

The report states that there has been more frequent micturition, but owing to the time of the nurse on night duty being claimed elsewhere, no exact estimation could be arrived at. 250 c.c. calculated approximately. The urine forwarded is pale, cloudy, without deposit. Reaction slightly alkaline. S.G. 1015. The albumen was separated by acid precipitation and boiling frequently repeated. Collected on a weighed filter (previously heated to 110° C.), dried at 110° C., and kept over sulphuric acid in the desiccator until the weight was found constant. Total for 100 c.c. 0·0304 grm. Urea 6·2. Chlorides ·4 per cent.

Sample 6 for 2nd September.

Report. Micturated freely. Urine pale straw colour. Slightly acid. S.G. 1002. A very faint trace of albumen only present. Urea ·45. Chlorides ·4 per cent.

The importance of ascertaining whether urea is present in the intestinal evacuations as an excretion, hereby acting as one of the sources of the nitrogen determined, seemed to demand a special examination. As has been already stated urea was to be looked for in the fæces, as a result of contamination merely in a certain number of samples, but in other cases in which a careful separation of the excreta had been carried out, it seemed feasible to determine whether urea was present as a result of its elimination from the alimentary canal. If this could be demonstrated positively it would of course show that in the alvine excretion proper to the disorder under consideration, urea is at least an occasional constituent.

(Note.—A control experiment was made with a view of determining, firstly, what amount of nitrogen may be evolved by the hypobromite method from the fæces of a healthy milk-fed child, and secondly, how long the urea contained in urine mixed purposely with such fæces gives its full value of nitrogen.

The first experiment gave a total of nitrogen as evolved at about ·008 for the 24 hours' evacuations (a quantity so small that it may practically be neglected). Fresh urine which had been ascertained to contain ·788 per cent. of urea was mixed in the proportion of two parts of urine to three of strong watery extract of the same fæces. Immediately after the mixture the per-centage of nitrogen evolved represented ·78 urea, and the succeeding three days the same result was obtained without variation, the mixture retaining a feebly acid reaction throughout.)

By the hypobromite method which seemed sufficiently accurate, considering the doubt existing as to the absolute purity of the samples of fæces, the following estimations of nitrogen were made. Urea was the chief, though probably not the exclusive source of this nitrogen.

Sample 2 (Case II.) ·06 nitrogen per 100 c.c. fæces.
Sample 2 (Case III.) ·13 nitrogen per the 24 hours.
Sample 3. ·05 nitrogen per the 24 hours.
Sample 7. ·065 nitrogen per 100 c.c.

Of these samples, 2 (Case II.) had suffered contamination; the sample 2, 3, and 7 (Case III.) were supposed to be uncontaminated.

In order to procure the nitrate of urea in complete separation, the following process (recommended by Hoppe, Seyler) was followed. The fluid fæces were diluted with four volumes of spirits of wine, allowed to stand some hours and filtered, the filtrate evaporated at a moderate temperature on the water bath, the residue extracted with absolute alcohol and a little ether; the filtered-off fluid evaporated and the residue decomposed with pure nitric acid. The fat present was removed by careful washing with alcohol and ether, and the nitrate of urea was allowed to crystallise out of solution in a small quantity of water over sulphuric acid. By this method urea was recovered from all the above-mentioned samples.

I also separated urea from the fresh fæces by Haycraft's method of dialysis and subsequently obtained the oxalate from this in its crystalline form.

The presence of a small quantity of urea in certain samples was therefore beyond dispute, but though I am inclined to take the view that its occurrence there was not in all cases due to contamination, I cannot assert positively that such was not the case.

Serum albumen was a frequent constituent of the fæces and in some of the submitted samples was present in considerable abundance.* It was recognisable by all the usual reactions (sulphate of copper with caustic soda in the heat, nitrate of mercury in cold and heat, reaction to ether, concentrated hydrochloric acid, &c.).

In addition to this, large quantities of *Casein* were present in all of the samples: thus, Case II., sample 5, 66 c.c., of sample taken, acidulated with acetic acid, heated to 40° C. in a double beaker. Filtered under suction through a platinum tipped filter for six hours. Residue transferred to a Drechsel's extractor, and was for four days, from four to six hours each day, extracted with ether. After complete extraction of all the fat and colouring matter, the residue dried at 100° C. and weighed on filter likewise dried at 100° C., yielded ·7245 grm. or 1·2075 per cent. of casein.

The original clear filtrate after the separation of the *Casein* was treated by boiling when a further copious precipitate occurred. This was separated by filtration, washed repeatedly with water, and with boiling alcohol, heated, dried at 110° C., and let cool over sulphuric acid. The filtrate again acidulated and boiled, &c. until no further precipitation occurred. The total obtained was ·2999 or ·5 per cent. albumen.

The large amount of casein recognisable by all typical reactions, is interesting as showing that the process of peptonisation, is incompletely carried out in the alimentary canal.

In the filtered-off fluid from fresh fæces, Case II., sample 3, a total of ·675 per cent. for the albumen and casein was obtained.

Ash and *Salts*—

Case III., sample 4.
Weight of platinum crucible = 11·7628 grms.
„ „ plus fæces = 14·8514. „
Therefore fæces = 3·0886. grms.
Ash after ignition ·3626 grm.

The salts most abundantly present in the ash after ignition were :—
Sodium sulphate = ·0047.
Sodium chloride = ·0772.
Sodium phosphate = ·0487.
Calcium phosphate = ·0609.

In comparison with the analysis made by Enderlin† of the ashes of the human fæces, the phosphates of the earths seem to be markedly diminished, whilst the phosphate and chloride of sodium are relatively increased. The earthy phosphates are however present in much smaller proportion in milk-fed children. The presence of the soluble phosphate and chloride of sodium in relatively large quantities, is probably explained to a large extent, by the fact of their rapid passage through the intestinal canal, otherwise their greater absorption would have been effected.

In Case II., sample 5, in which the fæces contained no less than 10·2 per cent. solid residue, the relationship of the salts was markedly altered. Ash = 2·54 per cent. Salts 1·3668 (soluble ·12 and insoluble 1·247) per cent.

---

* In the fæces of healthy milk-fed children no albumen is present according to Wegscheider. Jahresbericht d. Thierchemie, vii. 1877.

† Ann. d. Chemie, xlix. s. 335.

Causation of "Diarrhœa," by Dr. Ballard.

I will now turn to a consideration of the total nitrogenous excretion, in relationship to the food taken in the cases of infantile diarrhœa, already referred to in detail.

Case II.

Samples.	Date.	Time.	Calcu. of Fæces.	Fæces dry Residue.	Total Nitrogen.
2	August 28	24 hrs.	350 c.c.	5·2 grms. per 100 c.c.	·66248
3	„ 29	Do.	255	5·46 „ „	·901
4	„ 30	—	136	15·3 „ „	·77958
5	„ 31	—	121	10·2 „ „	·444
6	Sept. 1	—	260	8·22 „ „	·940
7	„ 2	—	15 per cent.	21·97 „ „	(1·2215 per cent.)

Case III.

1	August 27 -		105 (in 12 hours)	4·51 grms. per 100 c.c.	·3788 for 24 hours. (·04 for dried grm.)
2	„ 28 -		16 c.c. collected -	5·5 grms. „ „ -	(·0336 per dried grm.)
3	„ 29 -		110 c.c. - -	6·4 grms. „ „ -	·276.
4	„ 30 -		205 c.c. - -	9·2 grms. „ „ -	1·056.
5	„ 31 -		183 c.c. - -	11·7 grms. „ „ -	1·348.
6	Sept. 1 -		—	9·8 per 100 grms. -	(·0847 per dried grm.)
7	„ 2 -		—	12·39 per 100 grms. -	(·0749 per dried grm.)

As it is impossible to present an unbroken series of the daily total nitrogen excreted, I will formulate the nitrogen per dried gramme in the following Table:

Case I.	Case II.	Case III.
Sample 1 = ·056	Sample 2 = ·0364	Sample 1 = ·04
„ 2 = ·042	„ 3 = ·0547	„ 2 = ·0336
„ 3 = ·0308	„ 4 = ·03748	„ 3 = ·0392
	„ 5 = ·036	„ 4 = ·056
	„ 6 = ·044	„ 5 = ·063
	„ 7 = ·0556	„ 6 = ·0847
		„ 7 = ·0749

Nitrogen from kidneys.

Case II., sample I.—Urea present in proportion of ·88 per cent.

Case III.

—	Date.	Total passed. (approximate.)	Urea.	Nitrogen.
Sample 1 -	August 28 - -	175 c.c.	·95 per cent.	= ·776 grm.
„ 2 -	„ 29 - -	190 „	·9 „	= ·797 „
„ 3 -	„ 30 - -	200 „	·9 „	= ·84 „
„ 4 -	„ 31 - -	150 „	1·1 „	= ·77 „
„ 5 -	September 1 -	300 „	·62 „	= ·867 „
„ 6 -	„ 2 - -	400 „	·45 „	= ·84 „

Total Nitrogen excreted in 24 hours.

Case III.

Date.	By the Fæces.	Urine.	Nitrogen.
August 27 -	·3788	—	—
„ 28 -	(·0336 per dry grm.)	·7757	—
„ 29 -	·276	·797	= 1·073
„ 30 -	1·056	·84	= 1·896
„ 31 -	1·348	·77	= 2·118
September 1 -	(·0847 per dry grm.)	·867	—
„ 2 -	(·0749 „ „)	·84	—

The nitrogenous and other food taken in this time was as follows. I append note of condition of patient:

Case II.

For 28th, 12 ozs. of milk, the white of one egg, ·5 ounce of brandy.
29th, 11 „ „ „ „ „ (better).
30th, 12 „ „ „ „ „ („).
31st, „ „ „ „ „ „ („).
1st, 20 „ „ „ „ „ (more relaxed).

Case III.

For 28th, some cows' milk, mother nursed three times in day and in night, no alcohol.
29th, cows' milk and soda, „ „ „ in 24 hours, has been very sick after cows' milk.
30th, „ „ } Not so well.
31st, „ „ }
1st, „ „ decidedly better. Had one egg and ½ oz. of brandy.
2nd, as above; decidedly better.

The nitrogen obtainable from 12 ozs. of milk (28th), 28·4 × 12 = 340·8, may be put down at 2·0946 + egg albumen ·62 grm.

Case II.

	Milk.	Egg.	
29th,	1·931	+ ·62	= 2·551.
30th,	2·106	+ ·62	= 2·726.
31st,	2·106	+ ·62	= 2·726.
1st,	3·491	+ ·62	= 4·13.

(*Note.*—With the view of ascertaining whether bodies having the characteristics of some of the ptomaïnes so carefully separated and described by Brieger, were capable of isolation from the fæces in unusual quantity in infantile diarrhœa, the following analysis was made:—

Eighty-three grms. of fæces were allowed to stand for four months under alcohol. The alcohol was filtered off and evaporated. The residue precipitated with basic acetate of lead, and decomposed with sulphuretted hydrogen; dissolved in water; precipitated with excess of mercuric chloride; filtered, and the filtrate decomposed by sulphuretted hydrogen; filtered partially, and slowly evaporated on water bath; residue extracted with absolute alcohol, evaporated, dissolved in water, precipitated by excess of platinic chloride. The platinum precipitated by sulphuretted hydrogen, filtered, evaporated, dissolved up in alcohol. Treated with animal charcoal to decolorise, of faint yellow tinge. Filtered and allowed to evaporate slowly over sulphuric acid. About ·01 grm. of a white, partly crystalline powder was thus obtained. The crystals consisted for the most part of delicate needles, but a few larger prisms were also present. A few of these crystals dissolved up in half a drop of water, and injected into the lymph sac of a brainless frog, caused in the first hour no symptoms, excepting a somewhat exaggerated reflex movement; this was succeeded by semitetanic extension of the legs, with muscular fibrillation, and in the course of a few hours by great impairment of reflex, from which the animal completely recovered in 36 hours.

The solution obtained and injected is certainly a mixture of two if not more substances. Unfortunately the very small quantity I obtained made a further separation impracticable, and it is therefore premature to do more than indicate the possibility of the existence of some ptomaïn-like bodies in the excreta of infantile diarrhœa.)

Summary.

It would be unwise to attempt to hasten to exact conclusions as to the nitrogenous excretions of infantile diarrhœa, from a consideration of the few chronic cases which have presented themselves for examination thus far. From the estimations made in these cases it may, however, be briefly stated:—

1. That the composition of the fæces shows a great increase of fluid, and a diminution of the solid residue as contrasted with normal fæces of infants of similar age. (In Case III., sample 2, the solid residue was only 5·5 per 100 c.c.)

Causation of "Diarrhœa," by Dr. Ballard.

2. That there is a marked diminution of water excreted by the kidneys.

3. That the total nitrogen passing away by the fæces is considerably increased. (The amount of nitrogen per grm. dried fæces is not distinctly greater than in the normal excretion, but the total solid residue from the copious alvine evacuations raises the figure considerably. The nitrogen contained per dried grm. increases as the purging abates, in Cases II. and III.)

4. That the chief source of this nitrogen is unabsorbed ingesta, excreted albumen, and probably small quantities of urea.

5. That the excretion of urea by the kidneys is not markedly increased, and in some instances appears distinctly diminished.

6. That the nitrogenous excretion is (reasoning from such data as are at our disposal) relatively increased to the total nitrogenous ingestion. Not only the absence of gain in body weight for the time being, but also its actual loss, as in Case II., would account in some measure for this occurrence.

Normal Excretion of Nitrogen.

The number of observations on nitrogenous excretion in healthy children is small, and the information obtainable from them has not been altogether satisfactory.

The difficulty of submitting an infant to a precise dietary, and of recovering the excreta without loss has made the experiment too uncertain in its probable results to tempt the experimentor to devote much time to its solution. Camera has, however, amongst others who have touched on the subject, contributed some very instructive and laborious observations dealing with nourishment and excretion in infants fed with the mother's or cows' milk. The analyses of nitrogen contained in excreta which were conducted for him by Dr. Hartmann, were made by Dumas' method, but as I have already explained the results of this method and of that of Will-Varrentrapp are, when both are carefully conducted, almost identical.

I have endeavoured to supply the deficiency which I myself felt, when attempting to estimate the significancy of the results obtained from cases of infantile diarrhœa, by making a number of observations of the excreta of infants up to two years of age. Some of these results will be now briefly stated.

Female infant, eight weeks old.—This child was weaned at the age of five weeks, and was thereafter fed entirely from the bottle. The weight at the time of the following estimations was 11 lbs.

This child took with great regularity 170 c.c. of milk and water (of which one-third was milk) every two hours both by day and night. The collection of urine commenced after the first recorded meal, and was satisfactorily accomplished, The collection of fæces commenced only when such time had elapsed after the last meal as it had been ascertained was taken in the passage of food through the alimentary canal. (This time was ascertained by mixing a number of caraway seeds with the milk of a given meal and noticing the time of their expulsion.) The bowels were moved five times on the day of collection, and the same number of times in the succeeding 24 hours.

In the 24 hours 2044·8 c.c. fluid was taken, of this 682 c.c. were milk, the remainder water.

Total evacua tions—

(*a.*) By the bowels, 36·5 grms.

Fæces, tenacious but unformed. Neutral in reaction.

Solid residue after three hours' evaporation in dry air bath at 110° C., 14·8 per cent.

Nitrogen from preliminary evaporation = 0·093 per cent.

Nitrogen from combustion ·583 per cent. fresh fæces.

Nitrogen actually excreted. Total ·2468 grm.

(*b.*) By the kidneys—

1197 c.c. urine. Very pale straw colour. S.G. 1004 (a mixture of all urine taken). Reaction very faintly alkaline. Urea ·31 grm. = 100 c.c. or 3·71 grms. urea, or 1·73 grm. Nitrogen in all.

The milk of the same source as that administered was carefully examined; it had a specific gravity of 1030. Dry residue 12·7 grms. per cent.

Combustion of 1 c.c. of fresh milk gave ·553 per cent. of nitrogen. This is equal to 5·53 grms. per 1,000 c.c.

The ingested and excreted nitrogen here bear the following relationship :—

Nitrogen ingested.	Nitrogen excreted.	
Casein Albumen Lactoprotein.	In Fæces.	In Urine.
3·77 grms.	·2468 grm.	1·73 grm.
	Total 1·9768 grm.	

The usual estimation of the casein present in milk is 3 per cent., with 75 per cent. of serum albumen. Casein obtained from cows milk yields 14·2 nitrogen per cent., whilst human milk yields somewhat more, viz., 14·65.

The proportion between incoming nitrogen and excreted nitrogen is nearly as 2 to 1. In one of Camera's estimations from a child of about twice the age of the one under consideration, it is as 5 to 3. For a child rapidly increasing in weight the incoming nitrogen must exceed the outgoing. Much of the excess cannot, however, be accounted for in this way, nor yet on the assumption that any material quantity is voided from the lungs.

A distinct difference exists between the excretas of suckled infants and those of the same age reared upon the bottle ; in the latter, the total amount of fluid imbibed after the usual addition of water to cows' milk is greater than in the former, therefore the urine is more abundant and of lower specific gravity. The fæces are also more abundant and firmer.

(Voigt, who has very carefully studied the nitrogen income and elimination in the case of dogs, concludes that all the nitrogen reappears in the fæces and urine when the animals are not increasing in size.)

Note.—From the same infant I was able to collect the meconium evacuated after birth, and to estimate its nitrogenous contents. The last trace of meconium was passed at the end of the first 24 hours after birth. Total evacuation = 128 grms. Dry residue after 5 hours' evaporation at 105° C., 23 per cent. (Davy* gives water at 72·7, Zweifel† at 80 per cent.) Nitrogen evolved in preliminary evaporation = ·049 per cent.

Combustion = 1·6835 per cent.

Total nitrogen present in meconium = 2·217.

In the case of another large and rapidly growing infant of 9 months receiving cows' milk and a small quantity of starchy food, the total nitrogen passed in the fæces on the day of the estimation was ·288 grm., or ·5488 per 100 grms.

By the urine in the 24 hours was voided 6·4 grms. of urea or 2·986 grms. of nitrogen. As only one evacuation of the bowels occurred in two days in the case of this child, the addition of half the nitrogen in the total evacuation $\frac{\cdot 288}{2}$ added to the nitrogen of the urea would represent very roughly the total excretion for 24 hours. This would amount to 3·13.

Nitrogen excreted per 24 hours :

In the Fæces.	In the Urine.	Total.
Grms. $\frac{\cdot 288}{2} = \cdot 144$	Grms. 3·0	Grms. 3·13

It is interesting to note that, in spite of an evacuation of the bowels occurring every second day, the total nitrogen for a single evacuation is not in excess of the normal amount.

* Davy Canstatts Jahresber d. Med. 1844.

† Zweifel Arch. f. gynäkol, 1875.

Causation of "Diarrhœa," by Dr. Ballard.

Boy of 1 year 9 months old. *Weather very warm:*
Diet.—Chiefly milk, with some starchy food and a small quantity of meat broth.
Fæces per diem = 52·5, tenacious, unformed. Reaction, slightly acid.
Evaporation of 4 grms. yields ·555 grm., or 13·8 per cent.
Preliminary evaporation yields ·00054 or ·00103 per cent.
Combustion yields ·2443 or ·465 per cent.
Nitrogen excreted as urea from kidneys:
In all, 520 c.c. passed = 10·5 grms. urea.
Nitrogen excreted per 24 hours—

In the Fæces.	In the Urine.	Total.
Grm. ·2448	Grms. 4·9	Grms. 5·1448

Boy of 2 years. Weather very warm:
Diet.—As above, but with addition of about 40 grms. of meat.
Fæces per day, 61 grms.
Evaporation of 3 grms. yielded ·4187, or 13·9 per cent. dry residue.
Preliminary evaporation, ·01138, or ·0186 per cent.
Combustion, ·3345, ·5484 per cent. nitrogen.
Nitrogen as urine from kidneys:
In all, 465 c.c. urine, S.G. 1029 concentrated, and yet yielded 13·9 urea.

Nitrogen excreted for 24 hours—

In the Fæces.	In the Urine.	Total.
Grm. ·3459	Grms. 6·483	Grms. 6·8289

For the sake of interest of contrast (though not for its actual value in the present connexion), I will give the result of two days' estimation of the nitrogen excreted by a healthy adult of 30, taking an abundant nitrogenous diet, with a large amount of starch.

Fæces for 24 hours = 155 grms., fæces solid, residue on evaporating 22·23 per cent., Total nitrogen from fæces = 3·3771. Will-Varrentrapp and Dumas (latter gave a slightly higher result). Urine from 24 hours, 1,529 c.c. Of this 906 c.c. was passed soon after meals, at which water or tea was drunk having a specific gravity of 1010 and 623 before meals, and after sleep having a specific gravity of 1021. The former contained 2·52, the latter 3·37 per cent. urea. Total 43 grms. urea, or 20 grms. nitrogen.

Nitrogen excreted in 24 hours—

In the Fæces.	In the Urine.	Total.
Grms. 3·3771	Grms. 20	Grms. 23·3771

2nd. Same adult:
Fæces = 130 grms. for 24 hours, leaving solid residue of 15·2 per cent.
Total nitrogen contained 3·1797 grms. Will-Varrentrapp and Dumas, latter gave slightly higher result.
Kidneys, 17·3 grms. of nitrogen.

Nitrogen excreted in 24 hours—

In the Fæces.	In the Urine.	Total.
Grms. 3·1797	Grms. 17·3	Grms. 22·4797

Causation of "Diarrhœa," by Dr. Ballard.

If the estimations of nitrogen obtained from urine and fæces are tabulated for the cases of infantile diarrhœa as well as for the excretions of the healthy subjects —though such a table is necessarily extremely imperfect—it still appears pretty plainly that, whether in proportion to the nitrogen of the food taken or to the nitrogen excreted by the kidneys, the nitrogenous excretion by the fæces is markedly increased in the pathological cases. Further, when the contrast is made with the normal excretion, this altered relationship becomes much more marked.

	Nitrogen excreted by		Nitrogen in Food.
	Fæces.	Kidneys Total.	
Case II.:	Grms.		
Diarrhœa, Sample 3	·901	- - -	2·551
„ 4	·779	- - -	2·726
„ 5	·444	- - -	2·726
Case III.:			
Diarrhœa, Sample 3	·276	·797 = 1·073	
„ 4	1·056	·84 = 1·896	
„ 5	1·348	·77 = 2·118	
Healthy child, 8 weeks	·2468	1·73 = 1·976	3·77
Child, 9 months	·144	2·986 = 3·13	
„ 21 „	·244	4·9 = 5·144	

Conclusion.

In conclusion, I desire to say a word with regard to the nature of the excretion of nitrogenous material: what are its chief sources in infantile diarrhœa?

As I have already stated, urea not merely accidental as contamination, but probably present as a constituent of the abnormal fæces forming a small proportion (Case III., sample 3, ·05 to ·276) of the total nitrogen present.

In Case II., sample 5, ·7245 grm. casein and ·49985 per cent. of albumen was obtained. The nitrogen present in the total excreta of these two substances for the day in question would be ·26458 per cent. or ·3201 for the total.

Now the total nitrogen estimated in the fæces for the day is ·444, which leaves only ·123 to represent a possible per-centage of urea and any other nitrogenous bodies present in small amount.

We may fairly conclude then that albuminoid bodies are the chief contributors to the nitrogen eliminated in the fæces.

Together with the excretion of urea by the kidneys, the fact that certain amounts of albumen were recognisable in almost all samples of urine examined, must be born in mind. The total given for Case III., sample 4, was ·036 grm. per cent., whilst in sample 5, obtained from the same patient, it had decreased to ·01 per cent.

In conclusion, I have the pleasure of returning my sincere thanks to Dr. Russell of St. Bartholomew's Hospital, who kindly placed a bench in his laboratory and many of the necessary appliances at my disposal, and who also forwarded the research by his valued interest therein. To Messrs. Lepraik and Orsman, who also promoted the accomplishment of the work, my hearty thanks are due.

APPENDIX C.

A detailed Account of the Characters of the Diarrhœal Illness in fatal Leicester Cases of different Durations.

Cases of less than 48 hours' duration.

The kind of history presented by the 20 cases of less than 48 hours' duration was this:—

For the most part the attack of illness was sudden, unexpected, unlooked for, and not only was the first burst of the illness sudden, but it was also severe. In only one case

Causation of "Diarrhœa," by Dr. Ballard.

is it noted that the child was "cross" in the morning, the attack commencing in the afternoon. In another it is noted that the bowels were observed to be looser than usual for a few days previously.

Usually diarrhœa and vomiting set in together, or within a very short interval the one from the other. It was so in 16 out of the 20 cases. In two of the remaining cases there was no vomiting at all, either at the commencement or subsequently; in one (the illness having commenced at 6 p.m.) it appeared on the second day of illness; in one the occurrence of vomiting is not recorded. The diarrhœa commenced usually with profuseness. and the vomiting with severity. In three cases it is noted that the diarrhœa was slight at the outset; in two of these it became more profuse as it went on; but in one it remained very slight throughout, the vomiting being the leading and most prominent symptom.

The diarrhœa, once profuse, usually continued profuse until death; it is described as "incessant," "deluging," "running like water from a tap." In one case only did it remit. a little in profuseness after the earlier discharges, but recurred with profusion on the second day, the infant dying in 26 hours. In one case in which the diarrhœa is stated not to have been *very* copious, both this and the vomiting ceased before death; and in one child (aged 16 months) who died after only about 12 hours' illness, the vomiting, severe at the outset, and the diarrhœa so profuse as to soak through the bed, both ceased in about three hours from their commencement. The account generally given of the stools is that they were "like water," either but faintly tinged, or yellowish or greenish in colour. In only two cases was there prolapsus of the bowels towards the last; in one of these the evacuations contained a little blood.

The vomiting was not so generally persistent as the diarrhœa. In some cases it only occurred at the outset, or ceased after a few hours. In two cases, as mentioned above, there was no vomiting throughout the illness.

In these very brief cases indications of exhaustion soon occurred, great pallor, relaxed features, coldness of surface, sweating, embarrassed breathing, and the other well-known signs of collapse.

For details of the occurrence of convulsive phenomena in cases of this and other periods of duration, see Appendix G.

Cases of a Duration of Two and under Four Days.

The 58 cases of two days and under four days' duration, still very acute cases, differed little in their general features from the shorter and even more acute cases just described.

Suddenness and severity of onset was much less common, only 12 of the 58 cases being noted as having commenced in this manner. In six cases some premonitory "ailing," "out of sorts," "feverishness," "crossness," or "fretfulness," is noted, but it may have occurred in other cases also. In a small number of cases some unaccustomed looseness of the bowels for a few weeks previously had been observed.

The concurrence of diarrhœa and vomiting at the onset was less frequent than in the less prolonged cases. It was observed in 30 out of the 58. In nine cases there was no vomiting either at the commencement or in the progress of the case. In two the occurrence or non-occurrence of vomiting is not mentioned upon the notes. In 21 cases out of the 58 the illness commenced with diarrhœa only, vomiting not being observed until the second day of illness or later; five of the cases set in with vomiting alone; in four of these the diarrhœa commenced the next day; and in one of them there was no diarrhœa until the vomiting ceased, a few hours before death (three days' duration), and then it was extremely profuse until death. Nor did the diarrhœa set in usually with so much profuseness as in the first class of cases, although it did so mostly in those of sudden onset. In 13 of the cases the diarrhœa was slight or moderate in amount and frequency on the first day, and in four of them continued so throughout the illness. In the other cases it increased in severity usually on the second day or later, and sometimes rather suddenly.

The diarrhœa having become profuse, usually continued so to the end. But in 14 of the cases it was not so. In two of them it lessened after the first day, the vomiting, however, continuing, and in 12 of them it altogether ceased at various periods before death. In one (of three days' duration), of the 14 cases which commenced with vomiting alone (38.81),* there was diarrhœa, frequent, on the second day only, and

* These numbers in brackets are a reference to my Register Number of the Case in a particular year, *e.g.*, Register Number 38 in the 1881 series of recorded cases; and so on throughout Appendix C.

the vomiting and diarrhœa then ceased together; and in another case of similar duration in which there was diarrhœa (moderate) only on the second day the vomiting continued to the last. In the remainder of these 14 cases the diarrhœa came to an end either on the day before death or some hours before death, the vomiting in some of them continuing to the last, and in some ceasing with the diarrhœa if it had not ceased previously. There were two cases in which, after the first violence of the diarrhœa, it lessened on the second day, but became severe again on the third day, the renewed severity continuing until death; in one of these cases (21.82) there was no vomiting throughout the illness; in the other there was no vomiting until the increased severity of the bowel discharge occurred. In another case the symptom, diarrhœa, was absent altogether on the second day (61.81), but afterwards recurred with violence and lasted to the end. This was a case, again, in which there was no vomiting throughout the illness. But in this instance there was no suspicion of improvement on the second day, for the diarrhœa was simply replaced for a time by convulsions. The characters of the diarrhœal discharge was similar to those of the cases of shorter duration. If not watery at the first the motions mostly became so in a short time; they were mostly green in colour, and in two cases stringy and blood-streaked, and in one case watery with blood streaks on the napkin.

It is stated above that in nine cases there was no vomiting from the beginning to the end of the illness. In other five it existed alone, without any diarrhœa, until the second day or later. It was also less persistent than in the cases of shorter duration, not quite so commonly continuing to the end. In four cases the vomiting only occurred on the first day of illness and then ceased, not to recur. In two it only occurred on the second day of illness and did not recur. In four it ceased when the diarrhœa ceased. In two it ceased the day before death; in one of these the diarrhœa continued, and in the other the diarrhœa had ceased the day before. It varied in severity; in some cases it was only slight, but in some severe and prostrating. In one case (159.82) it became more severe as soon as the diarrhœa ceased on the morning of the day of death, and continued very severe until death.

Cases of Four and under Seven Days' Duration.

Of these there were 91; they were characterised as follows:—

Suddenness and severity of onset was even less common than in the last series of cases. Only 11 out of the 91 are noted to have thus commenced. In six it is noted that the child had been previously "cross," "ailing," "restless," "out of sorts," or unusually "peevish": but again these premonitory indications might have occurred in other cases, although not particularly observed or noted. In a small number of cases the bowels are stated to have been habitually loose for some weeks previously.

The concurrence of diarrhœa and vomiting at the onset is noted as having happened in 46 of the 91 cases, that is to say, with about the same frequency as in the last series of cases. In 10 cases, that is to say, much less frequently than in either of the former series, there was no vomiting either at the commencement or at any period of the illness. In five, the occurrence or non-recurrence of vomiting is not recorded. In 35 cases out of the 91 the illness commenced with diarrhœa only, vomiting, when it occurred, not occurring until the second or third day, or later. Five of the cases set in with vomiting alone. In one of these (a case of six days' duration), there was no diarrhœa at all until the fourth day of illness (125.82), on the cessation of the vomiting, and then it was extremely severe until the end. In 20 of the cases the diarrhœa is noted to have been slight or moderate at first; in only four of them did it continue so. In the rest of the 20 cases it became severe on the second or third day, or later, sometimes with vomiting, which had not been present before, and sometimes with an increase of previously existing vomiting; and in one case, on the second day, with cessation altogether of vomiting (19.82). These increases of severity sometimes had a character of suddenness.

In the majority of the cases the diarrhœa once become profuse continued so to the end, but in nine cases it lessened in severity as the case went on, and thereafter remained slight or moderate. In one of these cases (82.81), the diarrhœa lessened on the cessation of the vomiting on the second day, and the stools, which had been green, re-assumed their yellow colour, yet the case was fatal in four days. In five other cases the diarrhœa lessened or altogether ceased for a day, and then recurred with severity until death. This kind of remission happened towards the latter part of the illness. In nine cases the diarrhœa ceased altogether for some time before death, the vomiting ceasing at the same time. In five of these cases this happened after two or three days'

Causation of "Diarrhœa," by Dr. Ballard.

illness; of these cases one was fatal after six days' illness, one after five days' illness, and three after four days' illness. In the remaining four cases it happened at periods varying from 10 hours (fatal in four days) to two days before death (cases fatal in six days). In four of the cases the diarrhœa was slight or moderate in amount throughout the illness. The stools were, with few exceptions, watery, especially when the diarrhœa was severe—"running away like water" was the term commonly used to describe them—sometimes they were slimy, also mostly green in colour, and in two or three cases containing a little blood.

In 10 cases there was no vomiting throughout the illness. In five, where the illness commenced with vomiting alone, it stood alone without any diarrhœa until the second day or later.

The period of commencement and duration of the vomiting is shown in the tables of Appendix D. In some cases it was only slight or occasional. In the cases where the diarrhœa, moderate at first, became severe later on, its increased severity was commonly associated with an increase of vomiting previously observed or with the occurrence of vomiting previously absent; and where the diarrhœa ceased before death the vomiting usually ceased with it. There was only one case where retching first occurred on the cessation of the diarrhœa on the second day (59.81). This was a case fatal in four days.

Cases of 7 *and under* 14 *Days' duration.*

Of these there were 90. Suddenness of onset was of rare occurrence; only four were thus characterised, cases lasting respectively seven, eight, and twelve days. Even of those in which the diarrhœa was severe at the commencement only two appear to have been free from some preliminary looseness, and but few of the cases beside the above commenced with severity. In 11 of the cases there had been some preceding ailing; either they had been dull, feverish, or dozy, or the child had been wasting, or there had been some looseness of the bowels for a short time before the illness.

The concurrence of diarrhœa and vomiting at the commencement is noted in 41 of the 90 cases, that is in nearly as large a proportion of them as in the last series of cases. In 14 of the 90 cases there was no vomiting either at the commencement or at any subsequent period of the illness. In one case only was the occurrence or non-occurrence of vomiting not recorded. In 41 out of the 90 cases the illness commenced with diarrhœa only, and in these cases mostly the vomiting (where it occurred at all) was either little or very occasional, or did not occur until after the diarrhœa had lasted some days; in two cases not until the 12th day of the illness (129.81 and 83.81); in three not until the eighth or ninth day; and in five not until the sixth or seventh day. When the vomiting was deferred beyond the second day, it was usually the accompaniment of an increase, often a sudden increase, of a previously slight or moderate diarrhœa. Seven of the 90 cases set in with vomiting alone, the diarrhœa following on the second, third, fourth, or in one case on the seventh day. One of these cases was a remarkable one (170.82), because from the first the vomiting was very severe; the diarrhœa appeared on the third day on the temporary cessation of the vomiting, and the two, vomiting and diarrhœa, alternated several times until death, after 10 days' illness. In 22 of the cases the diarrhœa is noted as slight or moderate at the first. In five of these it continued so throughout the illness, but in 17 of them the diarrhœa became severe as the illness proceeded, but at different periods of the illness. The following are some useful particulars of these 17 cases:—

104.81. Increased severity on 3rd or 4th day, with first occurrence of vomiting. Duration of illness, 10 days.

122.81. Increased severity on 4th day; no vomiting throughout. Duration of illness, 10 days.

68.81. Increased severity on 5th day; no vomiting throughout. Duration of illness, 1 week.

45.81. Increased severity on 6th day, with first occurrence of vomiting. Duration of illness, 10 days.

138.82. Increased severity on 6th day; vomiting began 2nd day of illness. Duration of illness, 7 days.

119.81. Increased severity (sudden) on 6th day, with first occurrence of vomiting. Duration of illness, 9 days.

120.81. Increased severity on 6th or 7th day, with first occurrence of vomiting. Duration of illness, 9 or 10 days.

156.82. Increased severity on 7th day; vomiting on that day only. Duration of illness, 9 days.

110.81. Increased severity on 7th day, with first occurrence of vomiting. Duration of illness, 9 days.

145.81. Increased severity on 9th day, with first occurrence of vomiting. Duration of illness, 13 days.

100.81. Increased severity on two last days, with first occurrence of vomiting. Duration of illness, 9 or 10 days.

129.81. Increased severity on 12th day, with first occurrence of vomiting. Duration of illness, 13 days.

99.82. Increased severity on two last days, with severe retching. Duration of illness, 13 days.

107.81. Increased severity in last 29 hours, with severe increase of vomiting. Duration of illness, 7 or 8 days.

20.82. Increased severity in last 12 hours; no vomiting throughout. Duration of illness, 1 week.

24.82. Increased severity undetermined; vomiting from the first. Duration of illness, 11 days.

In the majority of the cases the diarrhœa, once become profuse or severe, continued so to the end; but in six cases it lessened in severity as the illness went on, and remained slight or moderate to the last. In one of these cases there was no vomiting throughout; in another both the diarrhœa and the vomiting lessened on the 3rd day, but the illness was fatal in 10 days; in another, which began severely but which had no vomiting throughout, and was fatal in nine days, there was little diarrhœa the last few days; in another, fatal in seven days, the diarrhœa, moderate from the first, lessened on the 4th day, but then vomiting commenced, and continued until death; in another, which had vomiting or retching throughout, and was fatal on the 10th day, there was little diarrhœa after the 8th day. There were eight cases in which remissions of the diarrhœa were observed, but only one in which it actually ceased for a time, to recur subsequently before death. This was the case (170.82) in which the diarrhœa alternated several times with severe vomiting, and was fatal in 10 days. The remissions usually occurred about the latter end of the first week of illness, the diarrhœa recurring with severity towards the close of the case. There were nine cases in which the diarrhœa ceased altogether some time before death. In two of these cases, one of seven and the other of eight days' duration, it ceased after three days, together with accompanying vomiting (95.81 and 10.82); in one (142.81) of seven days' duration, on the 5th day; in another of about two weeks' duration (97.81), in a few days; in two, both of eight days' duration (129.82 and 145.82), two days before death; in two (19.81 and 28.81) the day or the night before death; and in one (8.82) on the day of death. In these instances where there was vomiting it mostly ceased at the same time. In five cases the diarrhœa is noted as slight or moderate throughout the illness. In the severe cases, or when the diarrhœa from being moderate became severe, the stools were watery, "running like water," but in the early stages, or when less severe, they were often loose and slimy. They were nearly always green, even when the diarrhœa was slight or moderate in amount.

In 14 cases there was no vomiting at any period of the illness. In the cases where the illness commenced with vomiting alone, it stood alone without diarrhœa until the 2nd, 3rd, 4th, or even 7th day. The period of the commencement and the duration of the vomiting is shown in the tables of Appendix D. In some of the cases the vomiting was only slight or occasional. The vomiting sometimes ceased, while the diarrhœa ran on to the last.

Cases of 14 *and under* 21 *Days' duration.*

Of these there were 29. Only two of them are stated to have commenced suddenly, and only one other with any amount of severity; and there was only one in which it was stated that the child was "poorly" the day before the illness commenced, and one in which there was some preliminary looseness. But, as in the previous series of cases, this may be more or less short of the truth.

The concurrence of diarrhœa and vomiting at the onset is noted in 14 of the 29 cases. In only two of the 29 was vomiting absent altogether throughout the illness; and in two cases the occurrence or non-occurrence of vomiting during the illness is

Causation of "Diarrhœa," by Dr. Ballard.

not recorded. In nine cases the illness commenced with diarrhœa alone, and in these cases, when vomiting occurred at all and was recorded, it continued in one case only more or less throughout the illness, which lasted 14 days; in one case it commenced on the third or fourth day; in one it followed early, and continued off and on for only the first week; in one it occurred only on the ninth day; in three it commenced as late as the end of the first or one of the earlier days in the second week of illness. When it occurred on the third or fourth day, or later, it was mostly as an accompaniment of an increase in the severity of the diarrhœa. Four of the cases commenced with vomiting alone, the diarrhœa in one of these cases not commencing until the tenth day, the duration of the illness being 15 days (12.81). In the majority of the cases the diarrhœa was slight or moderate at first, and in three of them it continued so to the end. The general rule, however, in these cases was for the diarrhœa, whether severe or not at the outset, to become severe towards the end of the case, and sometimes suddenly. In one case (115.81) the character of the stools improved towards the last, and in another (147.81) there was little diarrhœa during the last few days. There were seven in which the diarrhœa remitted after a few days or ceased altogether, sometimes being absent for from four days to a week, and then recurring with violence and lasting to the end. In such cases as these, or when the diarrhœa ultimately became severe, whatever their character might have been at the first, the stools became watery towards the last, or, as they were described, "ran like water." They were generally green, either from the first or towards the last. In two cases only was vomiting absent from the beginning to the end of the illness. The period of the commencement and the duration of the vomiting is shown in the tables of Appendix. D. In one case (147.81) it was the prominent symptom of the illness. In several cases it came to an end several days before death, the diarrhœa, notwithstanding, continuing to the last.

Cases of 21 *Days' duration and upwards.*

Of these there were 52. They were all more or less tedious cases: six of them lasted for two months or upwards (15.81, 151.81, 162.81, 164.81, 75.82, 175.82), and seven of them five or six weeks (28.82, 87.82, 116.82, 136.82, 142.82, 162.82, 172.82). They were characterised as follows:—Either they were cases which were tiresome from the persistence of a moderate or slight diarrhœa for a long time, rather than at any time severe; or were cases which, after continuing thus for some weeks, became really severe towards the end, thus resembling in their features the acute cases of the first two series; or they were cases which, setting in with severity, appeared to improve, or almost get well, and then to relapse. Relapse in such cases happened about twice or oftener in the course of the illness, which usually ended with severe watery diarrhœa, like the cases of the first and second series.

The concurrence of diarrhœa and vomiting at the commencement of the illness was noted in 28 of the 52 cases. In six of them there was no vomiting observed either at the commencement or in the progress of the illness. In three of the cases the occurrence or non-occurrence of vomiting was not recorded. In 21 of the cases the illness commenced with diarrhœa alone. In these cases vomiting, if it occurred at all, did not usually appear until the diarrhœa had run on for one, two, or three weeks. In one case (113.81) of a month's duration, there was no vomiting until 12 hours before death, accompanying a sudden burst of severe diarrhœal discharge. In these cases, as in similar cases in the previous series, the vomiting occurred as an accompaniment of the increased severity of diarrhœa. None of the cases of this series of tedious cases commenced with vomiting alone. There were six cases in which the diarrhœa is noted as having lessened before death; two of these (of a month's duration) during the three days before death; one (of two months' duration) for a week before death; one (of over a month's duration) in the two weeks before death, and one (of nine weeks' duration) during the last three weeks of the illness. In four it altogether ceased several days before death. Altogether there were 20 of the cases in which it is noted that during the early weeks of the illness the diarrhœa was remittent. The stools were usually green, especially when the diarrhœa was severe.

The period of commencement and the duration of the vomiting is shown in the tables of Appendix D. It usually increased and decreased, disappeared and reappeared with the diarrhœa in the remitting cases. In some of the cases it was only slight or occasional, or it ceased altogether after a few days, notwithstanding that the diarrhœa went on.

APPENDIX D.

Vomiting as a Symptom of the Diarrhœal Malady.

The following details of the time of occurrence and duration of this symptom may be useful.

Occurrence and Period of Commencement of the Vomiting.

There were, among the 340 cases noted, 326 in which the presence or absence of vomiting as one of the phenomena of the illness is mentioned.

In 43 of them, *i.e.*, in 13·2 per cent., there was *no vomiting throughout.*

In 283 „ *i.e.*, in 86·8 „ *vomiting occurred* at some period of the illness.

In 19 cases in which the illness lasted under 48 hours,					it occurred in	17	cases, or	89·4	per cent.
„ 56	„	„	„	2 and less than 4 days,	„	47	„	83·9	„
„ 86	„	„	„	4 „ 7 „	„	76	„	88·3	„
„ 89	„	„	„	7 „ 14 „	„	75	„	84·2	„
„ 27	„	„	„	14 „ 21 „	„	25	„	92·5	„
„ 49	„	„	„	21 days and upwards	„	43	„	87·7	„
326						283			

Of the 283 cases in which vomiting occurred at some period of the illness—

In 196 it appeared at the commencement		of the illness, *i.e.*, in	69·2	per cent.	of the cases.
„ 14 „	on the 2nd day	„ „	4·9	„	„
„ 15 „	„ 3rd or 4th day or early in	„ „	5·3	„	„
„ 10 „	towards the end of the 1st or at the commencement of the 2nd week	„ „	3·5	„	„
„ 8 „	towards the end of the illness only.	- -	2·8	„	„

„ 7 it is said to have first occurred when, after a period of moderate diarrhœa, the illness became severe and alarming.

There were two other cases in which retching, but no actual vomiting, occurred on the cessation of the diarrhœa, in the one case on the 2nd day, in the other on the 5th day (the day before death.)

In the remaining 31 cases the actual time of the commencement of the vomiting was not ascertained.

Of the 196 cases in which vomiting occurred at the commencement of the illness,—

In 21 it was at first unaccompanied by diarrhœa. It stood alone as the prominent feature in the illness, the diarrhœa not occurring until the next day or later.

In 175 the vomiting and diarrhœa appeared together or nearly so, sometimes the one and sometimes the other preceding but by a short interval.

Of 19 cases which proved fatal within 48 hours,					vomiting occurred *at the commencement of illness* in	16	or	84·2	per cent.
„ 56	„	„	in	2 and less than 4 days,	„ „	35	„	62·5	„
„ 86	„	„	„	4 „ 7 „	„ „	51	„	59·3	„
„ 89	„	„	„	7 „ 14 „	„ „	48	„	53·9	„
„ 27	„	„	„	14 „ 21 „	„ „	18	„	66·6	„
„ 49	„	„	„	21 days and upwards,	„ „	28	„	57·1	„

Of 19 cases which proved fatal within 48 hours,					vomiting occurred *first on the 2nd day* in	1	„	5·2	„
„ 56	„	„	in	2 and less than 4 days,	„ „	8	„	14·2	„
„ 86	„	„	„	4 „ 7 „	„ „	4	„	4·6	„
„ 89	„	„	„	7 „ 14 „	„ „	1	„	1·1	„
„ 27	„	„	„	14 „ 21 „	„ „	0	„	0·0	„
„ 49	„	„	„	21 days and upwards,	„ „	0	„	0·0	„

Of 19 cases which proved fatal within 48 hours,					vomiting occurred *first on the 3rd or 4th day or "early"* in	1	or	0·0	per cent.
„ 56	„	„	in	2 and less than 4 days,	„ „	0	„	1·7	„
„ 86	„	„	„	4 „ 7 „	„ „	8	„	9·3	„
„ 89	„	„	„	7 „ 14 „	„ „	3	„	3·3	„
„ 27	„	„	„	14 „ 21 „	„ „	2	„	7·4	„
„ 49	„	„	„	21 days and upwards,	„ „	1	„	2·0	„

The cases in which the vomiting commenced towards the close of the illness, or not until the diarrhœal illness became severe and alarming, were cases mostly of a duration exceeding one week.

Causation of "Diarrhœa," by Dr. Ballard.

Duration of the Vomiting.

On the records of the 326 fatal cases in which vomiting is mentioned on the records, the period of the illness in which the *vomiting ceased* was mentioned in 195 cases—

In 120 it continued from the time when it began throughout the illness *to the end*	*i.e.*, in	61·5 p.c.
In 30 it ceased after a *few hours* or in the *course of the day* or *soon*, and *did not recur*	„	15·3 „
In 18 it lasted *a few days*, usually two or three days, and then ceased and *did not recur*	„	9·2 „
In 20 it continued until shortly before death, usually ceasing a day or two before death	„	10·2 „
In 2 prolonged cases (3 weeks and upwards) it ceased after the illness had lasted 2 weeks	„	1·0 „
In 5 it is stated to have ceased before death, but how long before is not stated	„	2·5 „

As regards the cessation of vomiting in cases of different duration—

In 13 cases of less than 48 hours' duration—

In 9 it continued persistently *to the end*	*i.e.*, in	69·0 p.c.
In 3 it ceased *soon* and did not recur	„	23·0 „
In 1 it ceased before death, but at a period not mentioned	„	7·6 „

In 37 cases of 2 and less than 4 days' duration—

In 21 it continued *to the end*	*i.e.*, in	56·7 p.c.
In 7 it ceased after a few hours, or in the course of the day, *or soon*, and did not recur	„	22·4 „
In 2 it ceased *after a few days* and did not recur	„	5·4 „
In 5 it continued until *shortly before death*	„	13·5 „
In 2 it ceased before death, but how long before is not mentioned	„	5·4 „

In 54 cases of 4 days' and less than 7 days' duration—

In 30 it continued *to the end*	*i.e.*, in	55·5 p.c.
In 10 it ceased after a few hours, or in the course of the day, *or soon*, and did not recur	„	18·5 p.c.
In 9 it ceased *after a few days* and did not recur	„	16·6 „
In 5 it continued until *shortly before death*	„	9·2 „

In 48 cases of 7 days' and less than 14 days' duration—

In 33 it continued *to the end*	*i.e.*, in	68·7 p.c.
In 6 it ceased after a few hours, or in the course of the day, *or soon*, and did not recur	„	12·5 „
In 4 it ceased *after a few days* and did not recur	„	8·3 „
In 3 it continued until *shortly before death*	„	6·2 „
In 2 it ceased before death, but how long before is not mentioned	„	4·1 „

In 19 cases of 14 days' and less than 21 days' duration—

In 11 it continued *to the end*	*i.e.*, in	57·8 p.c.
In 3 it ceased after a few hours, or in the course of the day, *or soon*, and did not recur	„	15·7 „
In 2 it ceased *after a few days* and did not recur	„	10·5 „
In 3 it continued until *shortly before death*	„	15·7 „

In 24 cases of 21 days' duration and upwards—

In 16 it continued *to the end*	*i.e.*, in	66·6 p.c.
In 1 it ceased *soon* and did not recur	„	4·1 „
In 1 it ceased *after a few days* and did not recur	„	4·1 „
In 2 it ceased after the illness had lasted 2 weeks	„	8·2 „
In 4 it continued *until a few days before death*	„	16·6 „

There were three cases recorded in which the vomiting and diarrhœa alternated, viz., 151 (1881), 170 (1882), 15 (1882), all over 7 days' duration.

Severity of Vomiting.

Causation of "Diarrhœa," by Dr. Ballard.

The vomiting varied in severity in different cases. In a few it was much in excess of the diarrhœa, and was *the leading feature in the illness*. In some it was severe, in some slight or occasional, or even occurred once only during the whole illness. In two cases in which it commenced on the second day of the illness it is described as producing immediate prostration, both cases being speedily fatal, the one in 70 hours and the other in three days from the commencement of the illness.

APPENDIX E.

On Attacks of Diarrhœa prior to the Fatal Attack.

Out of the 340 cases recorded there were 27 in which the fatal attack was not the first suffered from—the interval between the antecedent and the fatal attack varying from one week to three months. Some had had two or more similar attacks in the course of the same summer as their final fatal attack, and had apparently fully recovered from each of them. In one of these, however, the previous attack a month before the fatal one had left some looseness of the bowels behind. One case had also had a very severe attack in the summer of the previous year. In addition to these 27 there were 19 in which there had been some preliminary looseness of the bowels prior to the severe, sometimes sudden, fatal attack, as if the mischief which then culminated had been creeping on insidiously. In some of these cases of habitually loose bowels the fatal illness appeared to be at first merely an exaggeration of the habitual condition.

Of the 27 first alluded to who had had previous similar attacks, 10 were healthy children when they had their first attack. The remaining 17 were weakly or delicate from one cause or another. Taking all cases fatal of diarrhœa together we see from a Table on p. 43 that 57 per cent. of them occurred in weakly children. Hence we may infer that repeated attacks such as these occurred with unusual frequency in weakly children, although healthy children were by no means exempt from them. Of the other 19 cases only three were in reputedly healthy children (112.82, 4.82, 149.81). Again of the 27 cases—

1 was a case of 48 hours' duration.
6 were cases of 2 and under 4 days' duration.
8 „ 4 „ 7 „
5 „ 7 „ 14 „
4 „ 14 „ 21 „
3 „ 21 days and upwards.

APPENDIX F.

As to Offensiveness of Bowel Discharges.

There is one character of these "diarrhœas" which was all but universal in occurrence, and which on this account must be held to be of some pathological significance. This character was the *offensiveness* of the evacuations. The presence or absence of this character is recorded in 267 of the cases. In only 17 of them were the evacuations from the bowels stated not to have been offensive. In the remainder offensiveness was present; in a considerable number the stools are stated to have been "very offensive" or "horribly offensive," the offensiveness being in some instances defined as "a death-like odour." In one or two only was the offensiveness described as slight.

Causation of "Diarrhœa," by Dr. Ballard.

Offensiveness of the stools appears to be perhaps related in some way to the duration of the fatal illness. The 17 cases in which the stools were stated not to have been offensive were distributed among the cases of different durations thus :—

Duration.	Number of Cases.	Stools not Offensive.	Per Cent. of all Cases.
Under 48 hours - -	14	1	7
2 and under 4 days - -	43	3	7
4 „ 7 „ - -	64	4	6
7 „ 14 „ - -	77	6	8
14 „ 21 „ - -	23	1	4
21 days and upwards - -	46	2	4

So that offensiveness of stools would appear to be less frequently absent in cases of long than of short duration, a thing that may be due simply to the fact that there was a longer opportunity for it to occur and be observed. But absence of offensiveness of motions occurred mostly in cases in which the symptom diarrhœa was not severe, although the vomiting might be severe, in which the stools did *not* "run away like water," or in which the fatal illness appears to have been but the termination of a long continued and almost habitual condition. Few of them presented the characters of the severe disease which formed the large majority of the 340 cases under review.

Offensiveness of the bowel discharges then may be said to be an almost invariable characteristic of epidemic summer diarrhœa. But this characteristic was not invariably observed at all periods of the illness. In some cases indeed it is stated that the evacuations were offensive throughout, but in many of these it was not very marked at first or during the period while the diarrhœa remained slight or moderate at the commencement, but *it became much more so as the illness proceeded or towards the fatal termination.* There were other cases where the offensiveness was absent during all the earlier part of the illness not being observed until the increased severity (often sudden severity) of the diarrhœa which ushered in the end.

In remitting, or "off and on" cases of long duration, it was sometimes only noticed in the last or fatal exacerbation. I have not been able to associate it definitely with any other special morbid concurrent phenomena, such as greenness of the stools or convulsions.

APPENDIX G.

Causation of "Diarrhœa," by Dr. Ballard.

Convulsive Phenomena in Cases of Fatal Diarrhœa.

There were among the 340 Leicester fatal cases of diarrhœa 270 in which the occurrence or non-occurrence of these phenomena in the course of the fatal illness was recorded in my notes. The phenomena presented the marked characters of fits of infantile eclampsia, which I here term "major convulsions," or they consisted of such phenomena as clenching or "working" of the hands, rolling the head or eyes, twitching of the limbs, sawing the air with the arms, or what are popularly termed "inward convulsions," which I take to be laryngismus, all which I now designate "minor convulsions." The attacks of eclampsia varied in intensity from slight to severe, and from a single fit to repeated fits in the course of the illness.

The relation of *age* to the frequency of occurrence of convulsive phenomena in association with the diarrhœa of fatal cases is shown in the following table:—

TABLE A.

Age.	Total Cases.	Cases.				Per-centage of all Cases.			
		Major and Minor.	Major alone.	Minor alone.	None.	Major and Minor.	Major alone.	Minor alone.	None.
Under 3 months - -	86	73	58	15	13	84·9	67·4	17·4	15·1
3 and under 6 months - -	81	69	52	17	12	85·2	64·2	21·0	14·8
6 „ 9 „ -	52	39	31	8	13	75·0	59·6	15·4	25·0
9 „ 12 „ - -	24	21	19	2	3	87·5	79·2	8·3	12·5
12 months and upwards - -	27	20	18	2	7	74·1	66·7	7·4	25·9
	270	222	178	44	48	82·2	65·9	16·3	17·8

From which, *first*, the very great frequency of the association of convulsive phenomena with fatal infantile diarrhœa is demonstrated; and *secondly*, the fact that in two-thirds of the fatal cases fits of veritable infantile eclampsia occur at some period of the illness. *The distribution of these convulsive phenomena among the cases of short or longer duration* is shown by the following table:—

TABLE B.

Duration.	Total Cases.	Cases in which Convulsive Phenomena occurred.				Per-centage of all Cases.							
		Major and Minor.	Major alone.	Minor alone.	None.	Major and Minor.	Major alone.	Minor alone.	None.	Major and Minor.	Major alone.	Minor alone.	None.
Under 48 hours - -	16	12	8	4	4	75·0	50·0	25·0	25·0	78·7	63·9	14·8	21·3
2 and under 4 days -	45	36	31	5	9	80·0	68·9	11·1	20·0				
4 „ 7 „ -	75	66	56	10	9	88·0	74·7	13·3	12·0	88·0	74·7	13·3	12·0
7 „ 14 „ -	75	60	45	15	15	80·0	60·0	20·0	20·0	80·0	60·0	20·0	20·0
14 „ 21 „ -	20	16	14	2	4	80·0	70·0	10·0	20·0	81·3	64·4	16·9	18·7
21 days and upwards -	39	32	24	8	7	82·0	61·5	20·5	17·9				
All durations	270	222	178	44	48	82·2	65·9	16·3	17·8				

Causation of "Diarrhœa," by Dr. Ballard.

The following table shows the *frequency of occurrence of convulsive phenomena in healthy and weakly children respectively at different ages.*

TABLE C.

Healthy Children.

Ages.	Total at each Age.	Cases.				Per-centage of all Cases.			
		Major and Minor.	Major alone.	Minor alone.	None.	Major and Minor.	Major alone.	Minor alone.	None.
Under 3 months - - -	32	31	22	9	1	96·9	68·7	28·1	3·1
3 and under 6 months - -	32	27	18	9	5	84·4	56·2	28·1	15·6
6 „ 9 „ - -	22	17	14	3	5	77·3	63·6	13·6	22·7
9 „ 12 „ - -	11	11	9	2	—	100·0	81·8	18·2	—
12 months and upwards -	13	10	9	1	3	76·9	69·2	7·7	20·1
	110	96	72	24	14	87·3	65·5	21·8	12·7

Previously Weakly Children.

Under 3 months - - -	54	42	36	6	12	77·8	66·7	11·1	22·2
3 and under 6 months - -	49	42	34	8	7	85·7	69·4	16·3	14·3
6 „ 9 „ - -	30	22	17	5	8	73·3	56·7	16·7	26·7
9 „ 12 „ - -	13	10	10	—	3	76·9	76·9	—	23·1
12 months and upwards -	14	10	9	1	4	71·4	64·3	7·1	28·6
	160	126	106	20	34	78·7	66·2	12·5	21·2

The following table shows the *frequency of occurrence of convulsive phenomena in healthy and weakly children respectively, whose fatal illnesses were of different duration.*

TABLE D.

Previously Healthy Children.

Duration of Illness.	Total Cases.	Cases in which Convulsive Phenomena occurred.				Per-centage of all Cases.							
		Major and Minor.	Major alone.	Minor alone.	None.	Major and Minor.	Major alone.	Minor alone.	None.	Major and Minor.	Major alone.	Minor alone.	None.
Under 48 hours - -	4	4	3	1	—	100·0	75·0	25·0	—	90·5	76·2	14·4	9·1
2 and under 4 days -	17	15	13	2	2	88·2	76·5	11·8	11·8				
4 „ 7 „ -	33	29	22	7	4	87·9	66·7	21·2	12·1	87·9	66·7	21·2	12·1
7 „ 14 „ -	32	28	20	8	4	87·5	62·5	25·0	12·5	87·5	62·5	25·0	12·5
14 „ 21 „ -	9	6	6	—	3	66·7	66·7	—	33·3	83·3	58·3	25·0	16·7
21 days and upwards -	15	14	8	6	1	93·3	53·3	40·0	6·7				
	110	96	72	24	14	87·3	65·5	21·8	12·7				

Previously Weakly Children.

Under 48 hours - -	12	8	5	3	4	66·7	41·7	25·0	33·3	72·2	57·5	15·0	27·5
2 and under 4 days -	28	21	18	3	7	75·0	64·3	10·7	25·0				
4 „ 7 „ -	42	37	34	3	5	88·1	81·0	7·1	11·9	88·1	81·0	7·1	11·9
7 „ 14 „ -	43	32	25	7	11	74·4	58·1	16·3	25·6	74·4	58·1	16·3	25·6
14 „ 21 „ -	11	10	8	2	1	90·9	72·7	18·2	9·1	80·0	68·6	11·4	20·0
21 days and upwards -	24	18	16	2	6	75·0	66·7	8·3	25·0				
	160	126	106	20	34	78·7	66·2	12·5	21·2				

The following table shows the *number of cases of convulsive phenomena at each age in fatal diarrhœa of different degrees of acuteness, in the healthy and weakly, conjointly and separately.*

TABLE E.

Healthy and Weakly Together.

Duration of Disease.	Total Cases.	All Convulsive Phenomena together.					Major alone.					Minor alone.					None.				
		Months of Age.					Months of Age.					Monhts of Age.					Months of Age.				
		0–	3–	6–	9–	12 & upwds.	0–	3–	6–	9–	12+	0–	3–	6–	9–	12+	0–	3–	6–	9–	12+
Under 48 hours -	12	2	3	2	1	4	2	2	—	1	3	—	1	2	—	1	1	—	—	1	2
2 and under 4 days	36	14	11	5	2	4	12	9	4	2	4	2	2	1	—	—	6	2	1	—	—
4 „ 7 „	66	23	18	13	4	8	18	13	13	4	8	5	5	—	—	—	3	3	1	—	2
7 „ 14 „	60	25	22	8	4	1	21	14	6	3	1	4	8	2	1	—	3	4	5	1	2
14 „ 21 „	16	3	5	6	2	—	2	5	5	2	—	1	—	1	—	—	—	2	1	—	1
21 days & upwards	32	6	10	5	8	3	3	9	3	7	2	3	1	2	—	1	—	1	5	1	—
	222	73	69	39	21	20	58	52	31	19	18	15	17	8	2	2	13	12	13	3	7

Healthy Children.

Duration of Disease.	All kinds of Convulsive Phenomena.					Major alone.					Minor alone.					None.				
	Months of Age.					Months of Age.					Months of Age.					Months of Age.				
	0–	3–	6–	9–	12 & upwds.	0–	3–	6–	9–	12+	0–	3–	6–	9–	12+	0–	3–	6–	9–	12+
Under 48 hours -	—	1	1	1	1	—	1	—	1	1	—	—	1	—	—	—	—	—	—	—
2 and under 4 days -	5	6	1	—	3	4	5	1	—	3	1	1	—	—	—	1	1	—	—	—
4 „ 7 „ -	11	6	5	4	3	8	2	5	4	3	3	4	—	—	—	—	2	1	—	1
7 „ 14 „ -	11	10	5	2	—	8	7	4	1	—	3	3	1	1	—	—	1	2	—	1
14 „ 21 „ -	2	2	2	—	—	2	2	2	—	—	—	—	—	—	—	—	1	1	—	1
21 days and upwards -	2	2	3	4	3	—	1	2	3	2	2	1	1	1	1	—	—	1	—	—
	31	27	17	11	10	22	18	14	9	9	9	9	3	2	1	1	5	5	—	3

Weakly Children.

Under 48 hours -	2	2	1	—	3	2	1	—	—	2	—	1	1	—	1	1	—	—	1	2
2 and under 4 days -	9	5	4	2	1	8	4	3	2	1	1	1	1	—	—	5	1	1	—	—
4 „ 7 „ -	12	12	8	—	5	10	11	8	—	5	2	1	—	—	—	3	1	—	—	1
7 „ 14 „ -	14	12	3	2	1	13	7	2	2	1	1	5	1	—	—	3	3	3	1	1
14 „ 21 „ -	1	3	4	2	—	—	3	3	2	—	1	—	1	—	—	—	1	—	—	—
21 days and upwards -	4	8	2	4	—	3	8	1	4	—	1	—	1	—	—	—	1	4	1	—
	42	42	22	10	10	36	34	17	10	9	6	8	5	—	1	12	7	8	3	4

TABLE F.—Showing the per-centage of CONVULSIVE PHENOMENA at each AGE in FATAL DIARRHŒA of varying DEGREES of ACUTENESS in the previously HEALTHY and previously WEAKLY, and in both conjointly.

Duration of Cases.	No. of Cases of Diarrhœa. Ages in Months. 0—	3—	6—	9—	12+	Convulsive Phenomena of any kind. Ages in Months. 0 —	3 —	6 —	9 —	12 +	Major alone. Ages in Months. 0 —	3 —	6 —	9 —	12 +	Minor alone. Ages in Months. 0 —	3 —	6 —	9 —	12 +	None. Ages in Months. 0 —	3 —	6 —	9 —	12 +
HEALTHY AND WEAKLY TOGETHER.																									
Under 48 hours	3	3	2	2	6	66·6	100·0	100·0	50·0	66·6	66·6	66·6	–	50·0	50·0	–	33·3	100·0	–	16·6	33·3	–	–	50·0	33·3
2 and under 4 days	20	13	6	2	4	70·0 69·6	84·6 87·5	83·3 87·5	100·0 75·0	100·0 80·0	60·0 60·9	69·2 68·7	66·6 50·0	100·0 75·0	100·0 80·0	10·0 8·7	15·4 21·2	16·7 37·5	– –	– 10·0	30·0 30·4	15·4 12·5	16·7 12·5	– 25·0	– 20·0
4 „ „ 7	26	21	14	4	10	88·5	85·7	92·9	100·0	80·0	69·2	61·9	92·9	100·0	80·0	19·2	23·8	–	–	–	11·5	14·3	7·1	–	20·0
„ „ 14	28	26	13	5	3	89·3	84·6	61·5	80·0	33·3	75·0	53·8	46·2	60·0	33·3	14·3	30·8	15·3	20·0	–	10·7	15·4	38·5	20·0	66·6
14 „ „ 21	3	7	7	2	1	100·0 100·0	71·4 90·9	85·7 50·0	100·0 88·9	– 100·0	66·6 50·0	71·4 81·8	71·4 30·0	100·0 77·8	– 66·6	33·3 50·0	– 9·1	14·3 20·0	– 11·1	– 33·3	– –	28·6 9·1	14·3 50·0	– 11·1	100·0 –
21 days and upwards	6	11	10	9	3	100·0	83·3	64·7	90·9	75·0	55·5	76·7	47·1	81·8	75·0	44·4	5·6	17·6	9·0	25·0	–	16·7	35·3	9·1	25·0
Total -	86	81	52	24	27	84·9	85·2	75·0	87·5	74·1	67·4	64·2	59·6	79·2	66·7	17·4	21·0	15·4	8·3	7·4	15·1	14·8	25·0	12·5	25·9
HEALTHY.																									
Under 48 hours	–	1	1	1	1	–	100·0	100·0	100·0	100·0	–	100·0	–	100·0	100·0	–	–	100·0	–	–	–	–	–	–	–
2 and under 4 days	6	7	1	–	3	82·2	85·7	100·0	–	100·0	66·6	71·4	100·0	–	100·0	15·6	14·3	–	–	–	17·8	14·3	–	–	–
4 „ „ 7	11	8	6	4	4	100·0	75·0	82·2	100·0	75·0	72·7	25·0	82·2	100·0	75·0	27·3	50·0	–	–	–	–	25·0	17·8	–	25·0
7 „ „ 14	11	11	7	2	1	100·0	90·9	71·4	100·0	–	72·7	63·6	57·1	50·0	–	27·3	27·3	14·3	50·0	–	–	9·1	28·6	–	100·0
14 „ „ 21	2	3	3	–	1	100·0	66·6	66·6	–	–	100·0	50·0	66·6	66·6	–	–	50·0	–	–	–	–	33·3	33·3	–	100·0
21 days and upwards	2	2	4	4	3	100·0	100·0	75·0	100·0	75·0	–	60·0	50·0	75·0	50·0	100·0	50·0	25·0	25·0	33·3	–	–	25·0	–	25·0
Total -	32	32	22	11	13	96·9	84·4	77·3	100·0	76·9	68·7	56·2	63·6	81·8	69·2	28·1	28·1	13·6	18·2	7·7	3·1	15·6	22·7	–	20·1
WEAKLY.																									
Under 48 hours	3	2	1	1	5	66·6	100·0	100·0	–	60·0	66·6	50·0	–	–	40·0	–	50·0	100·0	–	20·0	33·3	–	–	100·0	40·0
2 and under 4 days	14	6	5	2	1	64·3 64·7	82·2 87·5	80·0 82·2	100·0 66·6	100·0 66·6	57·1 58·8	66·6 62·5	60·0 50·0	100·0 66·6	100·0 50·0	7·2 5·9	15·6 25·0	20·0 32·2	– –	– 16·6	35·7 35·3	17·8 12·5	20·0 17·8	– 33·3	– 33·3
4 „ „ 7	15	13	8	–	6	80·0	92·3	100·0	–	82·2	66·7	84·6	100·0	—	82·2	13·3	7·7	–	–	–	20·0	7·7	–	–	17·8
7 „ „ 14	17	15	6	3	2	82·4	80·0	50·0	66·6	50·0	76·5	46·7	33·3	66·6	50·0	5·9	33·3	16·7	–	–	17·6	20·0	50·0	33·3	50·0
14 „ „ 21	1	4	4	2	–	100·0	75·0	100·0	100·0	–	–	75·0	75·0	100·0	–	100·0	–	25·0	–	–	–	25·0	–	–	–
21 days and upwards	4	9	6	5	–	100·0	88·9	33·3	80·0	–	75·0	88·9	16·7	80·0	–	25·0	–	16·6	–	–	–	11·1	66·6	20·0	–
Total -	54	49	30	13	14	77·8	85·7	73·3	76·9	71·4	66·7	69·4	56·7	76·9	64·3	11·1	16·3	16·7	–	7·1	22·2	14·3	26·7	23·1	28·6

Studying by the aid of these tables the liability to convulsive phenomena of infants of different ages and having different degrees of acuteness of the fatal illness, we find :—

1. *In respect of all kinds of Convulsive Phenomena together* (Tables A. and B.).

1°. That they were observed to be *most frequent of all between the ages of* 9 *and* 12 *mos., i.e.,* at the period *when first dentition is usually actively in early progress,—next* most frequent at all ages under 6 mos., *i.e.,* when infants are very young and ought to be all at the breast, and when their life depends most on their *reflex* faculties. They were *least* observed between 6 and 9 mos., when *dentition* is *just commencing*, and in children over 12 mos. who are *more dependent for feeding, &c. on volition than on reflex acts.*

2°. That as respects the *acuteness of the fatal illness as measured by its duration*, they were observed *most frequently* in infants whose attack, although permitting of their survival for three days, yet carried them off in less than a week. These were *sharp illnesses* then, although not so acute as some on the record. They occurred with *least frequency in those that died most speedily from the attack. Severity of the malady* then clearly is *an element* in their production, but *time* is needed for their immediate cause to take effect. This *immediate cause* then is *not* likely to be the *first impression* of a contagium on the system, though it may be *something that the action of a contagium on the system produces.*

3°. *Distinguishing* now *between* the infants who were, previous to their attack by the malady, *healthy* and fairly strong, *and* those who were *weakly* from any cause, a class which of course includes such as suffered from "rickets," we find (Tables C., D., and E.) :—

(*a.*) That they were *more frequently observed in the healthy than in the weakly.*

(*b.*) As respects *age*, that this observation (*a.*) *applies, almost without exception, to all the groups of ages* specified, but *most markedly* to infants under 3 mos. of age (when infants are most dependent for their existence on the activity of their reflex functions), and to infants between 9 and 12 mos. of age (when first dentition is in most active early progress).

(*c.*) As respects *acuteness and severity of attack*, as measured by its duration, we find that the elements of *severity* of attack *and time* for the production of the convulsions are elements operative both in the healthy and the weakly; but that they are much *less obviously operative in the healthy* than in the weakly. Indeed, it is remarkable how very liable *healthy* infants very acutely attacked (dying under 48 hours) are to convulsive phenomena.

4°. The combined result of these observations respecting age and duration may be studied in Table F.

2. *In respect of the "Major" (Eclampsic) form of Convulsions.*

1° and 2°. What has been *said above as to the relations of age of the patient and acuteness* of the fatal malady to the occurrence of convulsions of all kinds together, *applies on the whole to the eclampsic form.* The same lessons are deducible from the study of this column of Tables A. and B.

3°. Tables C., D., and E. show that the observations (1, 3°, *supra*) as respects all kinds of convulsive phenomena taken together, do not apply universally to the major kind considered alone, for that—

a. The *liability of the previously healthy and previously weakly on the whole, i.e.,* taking all ages and all degrees of acuteness of disease together, to *this eclampsic form of convulsion was practically identical,* but

b. As regards *age* (Table C.), that the liability of healthy and weakly was not the same at each age group, for that *in every group but one* the observations 1. 3° (*a.*) *and* (*b.*) applied;—the *healthy were more liable than the weakly:* the *exceptional* group was that of the ages *between* 3 *and* 6 *mos.*, at which the weakly appeared much more liable than the healthy.

c. As respects *acuteness and severity of attack* as measured by its duration, we still see the influence of the factors *severity and time* in obvious operation in both classes of cases, but *severity most in the healthy* and *time most in the weakly.*

4°. The combined results of these observations may be studied on Table F.

Causation of "Diarrhœa," by Dr. Ballard.

3. *In respect of the "Minor" forms of Convulsive Phenomena.*

There is a suggestion in all the above tables that *these minor convulsive* phenomena are *in a degree complementary to the major* or eclampsic kind, and that, so far as they are so, they may be regarded as due to the same cause or causes; but the fact, that a decrease of per-centage of the major convulsions, under varying circumstances of age and acuteness of the illness, is not associated with a merely commensurate increase of per-centage of the minor, but with a greater or less increase, and *vice versâ*, serves to show that they are not altogether to be explained in this way.

1°. As respects the influence of *age*, Table A. shows that they were observed with vastly *greater frequency among infants under* 9 *months of age*, *i.e.*, in excitable extreme infancy and prior to the most active period of dentition, than at any later age; the age at which they were observed with the greatest frequency of all being from 3 to 6 months.

2°. As respects the influence of *acuteness of the malady*, as measured by its duration, Table B. shows no indication that severity of the malady has anything to do with their occurrence; but they were more frequently observed in the cases which died in less than 48 hours, probably then being really anticipatory to "major" convulsions, which would have required more time for their full development.

3°. *Distinguishing now between the previously healthy and the previously weakly* (Tables C., D., and E.) we notice.

a. That it is the difference of liability of the healthy and weakly respectively to these "minor" forms of convulsions which makes *the whole* of the difference in respect of convulsive phenomena taken as a whole (noted in 1. 3° (*a*.)). The difference seen in Table D. is most striking, the *liability of the healthy to this form of convulsion, having been nearly twice that of the weakly.*

b. As respects *age* (Table C), *both in the healthy and the weakly* we notice the *preponderant frequency* of these forms of convulsion *at ages under* 9 *months;* and that at nearly every age the greater liability of the healthy was observable. This greater liability of the healthy was *most markedly observable at the ages between* 9 *and* 12 *months*, when first dentition is usually in most active progress; and we must here take into account the tendency of rickets and other conditions of bad nutrition to retard dentition.

c. As respects *acuteness of the illness and severity*, as measured by its duration, *neither in the healthy nor in the weakly* group of cases do we see any evidence that *acuteness of the illness has anything to do with* the occurrence of these forms of convulsion. But, in *the case of the healthy*, Table D. shows most markedly that *lapse of time has much to do with it;* that, for their development, the cases must run on: probably the convulsions were mainly dependent on conditions of the system brought about by degrees. Need for lapse of time was *also observable in the case of the weakly*, but less obviously so, since we do not see in Table D. the same regular progression with lapse of time as in the case of the *healthy;* nevertheless, the minor convulsions were much more frequently observed in weakly infants whose illness had lasted beyond a week than in those in whom it was fatal in less than a week.

4°. The combined influence of age and duration on these forms of convulsion may be studied on Table F.

The Causes and Pathological Significance of Convulsive Phenomena in Infantile Diarrhœa.

The consideration of what has preceded has placed us in a favourable position for inquiry into this branch of the subject. As a matter of fact, the occurrence of convulsions in any form or at any age or period of infantile "diarrhœal illness" is universally regarded by the medical profession to be of grave import as respects the probable ultimate issue of the malady in recovery or death. And the above demonstration of the very great frequency with which convulsive phenomena of one kind or another are noticed in fatal, that is in the more severe, attacks of "diarrhœal illness," appears to indicate that for the most part (if not invariably) the convulsions observed arise from the direct operation of the cause, whatever it may be, that produces the

Causation of "Diarrhœa," by Dr. Ballard.

illness as a whole, or that they are intimately dependent on changes in the system brought about by some unhealthy condition invariably present in the malady, such unhealthy condition being a common-place result of the operation of its primary cause.

The principal *pathological conditions which are associated with convulsions in children* are now pretty well understood. I will endeavour to classify them, and then to consider each in its bearings upon the question at issue.

1. Among the *predisposing causes* the highest place must, according to all the more recent observations, be given to "*Rickets*." To use Dr. Samuel Gee's* words, "the "concurrence of the two diatheses, rickety and spasmodic, has been recognised for "many years." Rickets is a disease of mal-nutrition, the ultimate result of the long continued operation of causes interfering with the due and co-ordinate nutrition of the body, whether these may consist in actually improper, or insufficient infant alimentation, in the operation of diseases which themselves for a sufficient period of time have interfered with due nutrition, or in general unwholesome surroundings, such as those to which the poor especially are exposed so much in our large towns. But although rickets is thus the result of prolonged exposure to conditions of the sorts just mentioned, and so in its fully developed form is not met with in very young infants, yet the condition of mal-nutrition, out of which rickets ultimately issues, must be regarded as potentially the same; children thus *growing* rickety must for practical purposes be, as Dr. Gee says, regarded as "potentially rickety," and so in a condition to render them specially predisposed to convulsive affections.

2. *Anæmia* may be an exciting cause. It means strictly a diminution of the bulk of the circulating blood, a condition which can only result from a rapid and more or less sudden abstraction of that fluid; since, in gradual abstraction, the bulk is made up again as gradually by water, so that the condition produced is one not of anæmia but of spanæmia.

3. *Reflex irritation*, that is, a sufficient stimulus imparted to some of the afferent nerves, may produce convulsive phenomena. In this way we account for the convulsive affections which sometimes arise during dentition, the convulsions produced by worms in the alimentary canal, those by the administration to infants of unfit food, &c.

4. The *introduction* into the system (*i.e.*, into the circulating blood) *of the contagium of a specific disease* may be another exciting cause. When convulsions occur from this cause they form one of the *prodromata* of the disease which is about to be manifested. They are thus, that is to say, the first objective indication of the operation of the cause of such disease upon the body. The delicately balanced nervous system is that which shows first the operation of the contagium. Such manifestations in infants take the form of convulsions; in adults they take the form of what we call "rigor"—itself a form of convulsive affection. We see this cause of convulsions in operation at the outset of scarlet fever, measles, &c. Vomiting is also a convulsive affection, and its occurrence at the outset of scarlet fever, as the first indication of the contagium in the system, is one of the facts best known in practical medicine.

5. *Uræmia.*—This condition consists in the presence in the blood of material which, in the healthy condition, is duly and persistently discharged by the kidneys, but which, in certain diseases, especially inflammatory diseases of the kidneys, is not so discharged, but accumulates in the blood. The production of the uræmic condition requires time, and being a result of *accumulation*, does not occur instantly that the kidneys become disabled. Of all the acute diseases to which children are subject, there is none (with the exception perhaps of the diarrhœal malady) with which nephritis is more certainly associated than with scarlet fever: indeed in scarlet fever it constitutes an essential part of the disease. We have seen (p. 14) that, so far as pathological investigation can show it, it is an equally essential element in the diarrhœal malady which is the subject of this report. Uræmia, from disablement of the kidneys, also occurs in the latter stage of malignant cholera; and what we know as the "secondary fever" of cholera is, in fact, the result of the retention of matters which the disabled kidneys ought to have discharged.

6. *Actual intra-cranial inflammation.*—Perhaps this cause of convulsive phenomena should not be mentioned separately from uræmia, since it may arise from the uræmic condition, just as pneumonia and other local inflammations may.

---

* St. Bartholomew's Hospital Reports, Vol. III., p. 101.

Causation of "Diarrhœa," by Dr. Ballard.

Now to apply all this to the case in point, namely, the occurrence of convulsive phenomena in infantile diarrhœa. We may consider these possible causes of convulsions in the order in which they have been stated above, and ask whether all or any of them can be accepted as cause of the convulsions in diarrhœa, and which of them all is the most likely to be operative in their production.

[But, before doing so, I wish to note a belief which has grown upon me in the course of my professional life, although I am unable to demonstrate its truth. It is that there may go on, and that there does go on to a large extent, among persons, and notably among children, subjected for a long period of time to taking into their blood small or diluted doses of a blood-poisoning material, a process of adjustment, by virtue of which the system becomes more tolerant of the material than it is in persons to whose blood such poisons are strangers. That, in short, a sort of "acclimatisation" is established, so that a larger or a stronger dose is requisite to produce the specific effect in them than in the others; and so that when a sufficiently large dose or sufficiently strong dose is received it is slower to operate. I do not recollect having ever seen this proposition put into words, but I know that others beside myself have somehow acquired the same belief, and hence it is not unlikely to have been expressed by some previous writers.]

1st. As respects *rickets and the potentially rickety condition* as a predisposing cause of diarrhœal convulsions. I do not question for a moment that this may and does operate in diarrhœal as in other convulsions: but it cannot be admitted to have any predominant operation in face of the fact that the weakly children counted into Tables C. and D., amongst which the rickety and potentially rickety were assuredly included, were, on the whole, found less frequently affected by convulsions than the infants previously healthy. If rickets had much to do with these convulsive phenomena, we should too, I think, have found the minor forms of convulsions which include the notoriously rickety affection "laryngismus," decidedly of more frequent occurrence among the weakly, and not the reverse, which was so repeatedly the case.

2nd. As respects *anœmia*:—actual hæmorrhage (except of a trivial amount sometimes from the lower bowel) does not occur in infantile diarrhœa; but a *sudden* excessive discharge of watery fluid from the intestines may be regarded as an equivalent to sudden large hæmorrhage, in so far as the reduction in bulk of the circulating blood is concerned; and so this, when it has occurred, may be accepted as a sufficient cause for the production of a purely anæmic convulsion. *Rapidity* of reduction in the bulk of the blood must be regarded as essential to the production of an anæmic convulsion, and this rapidity of reduction is favoured when all liquids ingested are vomited. The convulsions in Case II., p. 78, were probably of this character, as also may have been the convulsions in those Leicester cases which were rapidly fatal with sudden deluging diarrhœa or abundant diarrhœa and vomiting. But in more lingering cases, where the bulk of the circulating blood is less rapidly reduced or continues being made up by the absorption of watery matters, this explanation of the convulsions cannot apply.

But beside the class of cases alluded to above there are many instances on the record of Leicester cases in which the convulsions followed upon large watery discharges; but it is remarkable that there were very few indeed when this sequence of events occurred at any other time than late in the illness—towards its close, indeed. This greatly lessens the significance of the sequence, so far as the convulsions being dependent on anæmia is concerned. I find among the Leicester cases 169 in which the period of illness at which convulsions first occurred is sufficiently recorded for my present purpose, and the following is an analysis of them.

Duration of Fatal Case.	Number of Cases that had Convulsions.	Convulsions First on Day of Death or shortly before Death.		Convulsions First on one or more of the last few Days before Death.	
		Number of Cases.	Per Cent.	Number of Cases.	Per Cent.
Under 48 hours -	8	7	87·5	—	0·0
2 and under 4 days	30	25	83·3	—	0·0
4 „ 7 „	54	32	59·3	14	25·9
7 „ 14 „	40	24	60·0	10	25·0
14 „ 21 „	12	6	50·0	6	50·0
21 days and upwards	25	15	60·0	7	28·0
All durations -	169	109	64·4	37	21·9

Thus, out of the 169 cases, 86 per cent. had their first convulsions more or less shortly before the close of the illness.

3rd. *Reflex irritation* as a cause of convulsions in diarrhœa must also be regarded as having a minimum of frequency of operation; for the reason that, otherwise, we shall have no explanation of the fact that convulsions do not habitually first occur early in the illness, as we should expect them to do if this were a common cause. The only suggestion of the operation of this cause in the cases I have on record is a greater tendency to the eclampsic form of convulsions in children between 9 and 12 months of age, when first dentition is already in active progress.

4. As a *prodroma* of the malady, as the *first* manifestation of the presence of a contagium in the system, convulsions did not occur in the Leicester experiences. Out of all the cases on the record, there were only four in which the convulsions are stated to have occurred upon the first day of the illness, and in only two of these did they occur *only* on that day; in the other two cases the fits recurred. In not one of these instances was the convulsions the first symptom. In each case they accompanied or followed upon diarrhœa. In the other nine cases they appeared early in the illness, mostly recurring during its course. Of these nine cases the duration of illness before death was, in three cases, two and under four days; in four, four and under seven days; in two, seven and under 14 days; so that the early convulsions seemed to import early fatality. But the convulsions were not of the nature of a prodroma. They indicated rather severity of attack.

5 and 6. The last of the suggested causes of the convulsions is *uræmia*, clinical indications of which are furnished by the suppression of urine (which we succeeded in making certain of—not always an easy matter—in a proportion of our fatal cases), drowsiness, stupor, blindness, &c., often observed towards the termination of the illness. The fact of the first convulsions occurring for the most part late in the fatal attack appears to favour this explanation.

TABLE EXHIBITING INTER-RELATIONS of CONVULSIVE PHENOMENA and some other SYMPTOMS in FATAL CASES of DIARRHŒA in LEICESTER.

1881.

Regstd. No. Case.	Age.	Duratn.	Only Slight or Moderate Diarrhœa at any time of Illnes.	On lessening of Diarrhœa or Vomiting, or both.	On Cessation of Diarrhœa.	On Cessation of Vomiting.	Diarrhœa ceased some time previously.
6	5 mos.	3 days	- - -	- - -	- - -	*V. on 2nd day only C. on 3rd day.	—
30	4 „	6 „	D. never severe, V.?	- - -	—	—	—
31	2 wks.	1 wk.	- - -	V. at commencement. D. frequently at first, then lessened. C. day before death.	—	—	—
37	7 „	6 days	- -	- - -	D. and V. ceased 3rd day. C. had been slight at commencement, but became severe from 3rd day till death.		—
39	15 „	2 „	- - -	- - -	D. and V. ceased on 2nd day, then convulsive "working" of eyes, and clenched hands.		—
41	3 „	3 „	- - -	- - -	On cessation of D, and V. day before death.		—
55	3 mos.	10 „	- - -	D. V. lessened on 3rd day. On 8th day rolling of eyes, clenched hands. 9th, comatose with twitchings.	—	—	—
59	14 days	4 „	- - -	- - -	- - -	- - -	No V., D. ceased on 2nd day. C. on 3rd day to end, with retchings.
70	10 wks.	4 „	- - -	- - -	D. and V. ceased on 3rd day, then C. recurring till death.		—
73	11 „	5 „	- - -	- - -	D. and V. ceased at end of 60 hours, then C., which recurred more severely till death. Urine suppressed on 4th day.		—
82	5 „	4 „	- - -	On 2nd day, when stools became yellow again.	- - -	V. ceased 2nd day, and then fixing of eyes and clenched hands.	—
95	15 „	8 „	- - -	- - -	- - -	- - -	V. and D. both ceased after 3 days. C. on day of death.
96	2 mos.	3 wks.	- - -	- - -	No V., D. ceased on suppression of urine occurring 2½ days before death, then rolling of head and eyes, and clenching of hands.	—	—
98	2 „	2 „	- - -	- - -	- - -	V., which began with 2nd week, ceased day before death, and then C. occurred.	—
132	16 „	1 day	- - -	- - -	- - -	On cessation of V. twitching of limbs and working of the arm and leg. D. severe.	—
136	9 „	4 „	- - -	- - -	- - -	- - -	V. ceased 2nd day. Several convulsions on 3rd day. D. continued. Blind before death.
144	7 „	61 hrs.	Only mod. D. throughout.	- - -	D. ceased after 24 hrs., then C. recurring to end. V. throughout.	—	—
147	6 „	14 days	D. mod. throughout. V. the prominent and most severe symptom throughout. Rolling head, and eyes turned up towards end.	- - -	—	—	—
158	2 „	22 „	- - -	- - -	D. and V. remittent. almost ceased last 4 days, when drowsiness, twitchings, and rolling of head and eyes occurred.	—	—
163	4 „	4 „	- - -	- - -	- - -	Severe V. on 2nd day, ceased day before death, then C. D. continued.	—
166	10 „	1 mo.	- - -	- - -	On cessation of D. (which had been excessive) 3 days before death. C. recurred to end.	—	—
167	5 „	5 days	- - -	D. and V. alarming on 3rd day, then lessened. Sl. C. on 3rd day, much more severe subsequently.	—	—	—
134	2 wks.	3 „	- - -	- - -	- - -	V. incessant till a few hours before death, then severe D. with C.	—

* V. stands here for "vomiting," D. for "diarrhœa," C. for "convulsions."

Regstd. No. of Case.	Age.	Duratn.	Only Slight or Moderate Diarrhœa at any time of Illness.	On lessening of Diarrhœa or Vomiting, or both.	On Cessation of Diarrhœa.	On Cessation of Vomiting.	Diarrhœa ceased some time previously.
4	11 mos.	6 days	- - -	- - -	V., which had been violent, and D. ceased on 5th day, and then C. occurred.		—
10	3 wks.	7 „	- - -	- - -	C. on cessation of D., which had been very copious and watery, on 4th day.		—
14	3 mos.	6 „	D. mod., not more than 6 stools per diem. C. on 1st day and recurred.	—	—	—	—
26	5 „	6 „	- -	- - -	Sev. D. and V. ceased on 4th day, then "inward convulsions," stupor and blindness, with suppression of urine.		—
27	12 wks.	5 „	- . -	D. lessened on 4th day, then suppression of urine and bad C. V. never ceased.	—	—	—
35	4 „	9 „	D. mod., only 5 or 6 stools daily, and very little V. Last 3 days "inward convulsion." Urine suppressed last 24 hours.	—	—	—	—
53	4 „	9 „	- - -	D. and V. little during last 2 days, but retching, when urine became suppressed, and "inward convulsions" recurred till death.	—	—	—
114	10 „	4 „	- - -	D. severe 2nd day, lessened on 3rd day, when C. occurred and became very severe towards end.	—	—	—

APPENDIX H.

An Account of some instances of Communicable Diarrhœa which occurred in the Rural Sanitary District of Helmsley, Yorkshire: By Dr. Bruce Low.

The following occurrences, which came under my observation in my own practice at Helmsley where, until recently, I was medical officer of health, appear to indicate that the disease which we term "diarrhœa" may sometimes spread by communication from person to person.

I. In the middle of the month of May 1876, in bright and breezy weather, the child (aged two) of a moorland farmer was suddenly attacked with violent diarrhœa. The farmhouse was a lonely one, situated on the crest of an elevated and exposed mountain ridge 1,200 feet above the sea level, and facing due south towards the extensive Vale of York; behind and on either side of it lay miles of moorland. The house itself was small and low; the farm buildings and fold yard were situated 200 yards away from it. The privy pit was in the garden behind the house, distant from the latter 20 yards. It was of primitive construction and practically open to all the winds that blew on that bleak mountain. It was also "clean" and dry. The domestic water supply was piped from a spring to the house, and it was well protected from possible contamination. The people were industrious and cleanly, and were as well fed and clad as most persons of their class. The family at this time consisted of the farmer, his wife, two children, and two farm servants. Later on, the mother-in-law came to act as nurse. This woman, myself as medical attendant of the family, and my assistant, were the only persons who visited the house during the continuance of the illness. When the child was first taken ill the mother alone attended to it, and removed its soiled napkins. The smell from its stools was very offensive. The next day the mother was seized with vomiting and diarrhœa, resulting in frequent syncope. She took to her bed and the farmer became the nurse. The elder child (aged five) who slept in the sick room was then seized with the same symptoms. The evacuations of the mother and the two children were passed into a night-chair, which the farmer had to empty. He became ill with vomiting and purging the day after his wife was laid up, but was able to go about all the time, passing his diarrhœal discharges *into the garden privy*. Up to this time the servants had escaped, but the very day after the farmer began with diarrhœa his two farm servants were taken ill in the same way,

Causation of "Diarrhœa," by Dr. Ballard.

they having used the garden privy all along. The farmer's mother-in-law now arrived to help the sick family, but became violently sick and purged within 24 hours of her arrival. I myself, who lived five miles away, chanced to visit the house one afternoon just after the farmer's wife had passed a liquid and offensive motion into the night-chair: I was impressed by the very disagreeable odour in the close and badly ventilated sick room, but thought no more about it until the middle of the night, when I was seized with violent abdominal pain, purging, sickness, and ultimate syncope. Suspecting now the infectiveness of this diarrhœa, all motions were mixed with chloride of lime as soon as they were passed, and no cases followed in my family, with the single exception of my qualified assistant. This gentleman habitually used an ash privy out of doors, and could not, therefore, have received any infection from my evacuations, which were passed into a water-closet in the house. But it transpired that the assistant had also had the misfortune (during my illness) to enter the sick room at the farmhouse shortly after an offensive motion had been passed by one of the patients into the night-chair. Within 12 hours he developed an attack of vomiting and purging, with great prostration. These stools were passed into the ash-pit privy as usual, but an additional quantity of dry ashes was thrown on them together with some disinfectant (chloride of lime or carbolic acid); and shortly after the attack the privy was cleaned out. I myself had not partaken of food in the farmer's house; and I have no reason to suspect that my assistant did. No further cases occurred in my family.

The origin of this small outbreak is obscure. The child first attacked had not been from home, nor indeed had any member of the household excepting the farmer and his wife, who went occasionally to the market at Helmsley, where diarrhœa was then unknown. There had been no visitors for months, and no recognised sickness had occurred among the stock upon the farm. There was only one other medical practitioner besides myself in Helmsley, and if any cases of diarrhœa had existed I should most assuredly have known of them, and, moreover, I made careful inquiry into the matter and could discover none. The house was a solitary one and could not be seen from the road which crossed the moor, and, therefore, was little likely to be visited by sick tramps if any such ever passed that way. The mother attributed the first child's illness to a chill.

There had been no previous cases of diarrhœa of this sort known to have occurred in the house, but there had been a case of enteric fever (imported) in the person of the previous tenant two years before this. His stools had been buried without any attempt at disinfection in the garden. The garden had been dug over shortly before the present outbreak, but the child first attacked was seldom (if ever) there.

II. *The second outbreak* occurred in a street at Helmsley, and therefore under more complicated conditions than the outbreak just recorded. Still it was possible to follow the series of cases. In a row of six houses on the south side of the street, which ran due east and west, fourteen persons were attacked, one after the other, with diarrhœa. These 14 cases all occurred during the first two weeks of February 1880. The month of January was cold and dry, the rainfall being only ·19 of an inch. The first two weeks of February were also dry and cold. The first case occurred in the second house in the row, which shared its backyard and privy with No. 1. The adjacent houses were afterwards attacked. The two cottages, Nos. 5 and 6, were the last attacked: the other numbers having been attacked intermediately. The adult male members of these families were labourers who left their homes in the early morning, and returned late in the evening; none of these men, it was distinctly stated, used their home privies, and none of them became ill. Three persons not living in this particular row of houses suffered also from severe diarrhœa at this time, but in two of these instances the person so affected had been visiting a friend or relative in the row, and in each case was present in the sick room when a diarrhœal motion was passed (the illness developing in the visitor about 12 hours afterwards). The third instance is mentioned below. The origin of the outbreak was reputed to have been the foul condition of the privies which were ordinary ash-pit privies: They were situated 15 yards from the houses, and had no communication with each other. They had not been cleaned out for 12 months, owing to a disputed right of way. The farmer whose premises abutted on the backyards of the cottages refused to permit any cart to approach the back of these privies, and the occupiers had been reluctant to carry the contents through their houses into the village street. In nearly every case the filth was level with the seat, and giving out a very foul odour. The privy at No. 3 was the worst, and this cottage was also in a dirty state. A committee of three members of the sanitary authority visited the place to inspect the state of things for themselves. Two of the deputation contented themselves with viewing the scene

and standing "afar off," but the third gentleman, courageous and conscientious, went into the yard and privy of No. 3, and saw (and felt) its condition. The same night he was seized with pain in the abdomen, vomiting, and violent purging, causing fainting. This is the third case referred to above as occurring in a person who did not reside in the row. There were no other cases of diarrhœa at the time in the town nor in any other part of the district so far as could be learned: if there had been I should pretty certainly have known it. Right of way to the privies was at once obtained, and the privies were immediately emptied, and well sprinkled with chloride of lime, after which the outbreak suddenly subsided. Two years before this (in 1878) there had been an imported case of enteric fever in house No. 1, but no other cases of fever followed at the time. In October of 1880 (*i.e.*, eight months after the diarrhœa outbreak), a case of enteric fever occurred in the dirty cottage at No. 3, and in October 1881 (a year after this) another enteric fever case appeared in the same house. Both cases were under my care. No others followed in any of the other cottages, nor did diarrhœa recur. The origin of the fever cases could not be traced beyond the possible connexion with the imported case at No. 1. This row of houses had the same constant domestic water supply as the rest of the inhabitants of Helmsley, and it was piped to each house separately.

III. *The third outbreak* occurred during the third week of December 1882. A farmer, who resided in a remote valley, was seized with violent abdominal pain, purging, and vomiting. He had been to the weekly market at Helmsley, seven miles distant, the previous day. He remembered having noticed a bad smell in the rudely constructed urinal in the yard at the inn where he had put up his horse, and which was frequented on a market day by farmers and hucksters from a distance. The day following the farmer's attack, his wife and his daughter, aged 14, were similarly attacked. Another daughter, aged 12, who had been away on a visit, returned on hearing of her mother's illness, and she also was seized with violent diarrhœa.

After the Christmas holidays the two girls resumed attendance at the village school of Hawnby, two miles away. The youngest girl was still suffering from looseness of the bowels, and had, in consequence, frequently to use the school privy. Shortly after this, the schoolmaster heard of numerous cases of diarrhœa among the 40 children who attended the school, and, so far as he could learn, there was hardly a child who escaped the illness during the first three months of 1883. For some time the schoolmaster and his family remained free from the disease. His house adjoined the school. He had a separate privy, which was quite inaccessible to the school children. He had one child who attended school, but she used the teachers' privy, and not the children's privy at the school. One day, however, she went into this latter privy with some of the other girls, and the following night she developed violent diarrhœal symptoms. Her mother, the schoolmaster's wife, waited on her, and removed the evacuations from the sick room, and she too became ill the following day, as also did her other child, the youngest of the family, who remained in the sick room with her sister. The schoolmaster's wife, though ill, was able to continue using the garden privy (their private privy), and next day both her servant and the schoolmaster himself, both of whom used the garden privy, were taken ill with diarrhœa. The privies serving boys and girls of the school respectively had a common pit, one side serving boys, and the other girls, a partition being between. Boys and girls both suffered. The epidemic of diarrhœa also affected adults, but only adults in houses from which children attended the school; houses in the village of Hawnby, which had sent no children to school, escaped entirely. It is important to notice that in no case was the first member of the household to be attacked a person who was not attending the school. One instance of this transmission of the disease to the home circle was the following. One boy living about a mile from the village, at a farmhouse situated on a hillside, and attending the school, returned home one afternoon suffering from purging. He used the house privy, and soon his father, mother, sister, three brothers, and three farm servants were suffering from the same illness. In several of these there were bloody stools, and, in two of the servants, the looseness of the bowels continued for several weeks, with occasional passing of blood in the motions.

The village of Hawnby, where the school was situated, is picturesquely perched on the steep side (half-way up) of a bare and rocky ridge or spur from a range of oolitic hills which runs through the district. The houses are small and often dilapidated. Some are thatched. The water supply comes from a spring on the mountain-side above the village, and is pure and plentiful. The privies at Hawnby are the ordinary arrangement in the garden, much the same as elsewhere in the district. The population numbers 231 living in 59 houses.

Causation of "Diarrhœa," by Dr. Ballard.

The steep ridge or spur on which the village is built, runs into a large open valley formed by the confluence of five smaller valleys or dales. On all sides above the dales are wide and open moors. In the valleys, on the hillsides, and on the moors, are scattered small farmhouses, from which children attend the village school. There is therefore a mixed class of scholars coming from the village itself, and from the sequestered dales, from the moorlands and from the hillside farms for a distance of four or five miles round. Each farm has its own distinct water supply and in no case, except in the village, does one spring supply more than one house.

All the children, no matter whether from village, valley, moor, or mountain side, suffered in equal degree from this outbreak of diarrhœa. The only circumstance common to all the cases was attendance at the the village school. The epidemic which must have attacked at least 100 persons was restricted to the localities sending children to the village school in question. There were no other cases of diarrhœa in the district at the time.

The wife of the first case (the farmer who began in the third week of December 1882) gave her opinion that the illness was not contracted by her husband at Helmsley market, but was occasioned in the following manner: The valley where they lived swarmed with rabbits. In December there had been repeated and heavy falls of snow, followed by a rapid thaw. Large number of dead rabbits where found near the farmhouse after the thaw, and others could easily be caught; they were so thin, and weak, as well as "*swollen in the belly*" that they could not run when chased. The wooden spout in which the spring was conducted from the hillside to a convenient spot near the house, had become coated with a "*slimy green slush*" which the farmer's wife attributed to the continued washings of rabbit dung, carried by the melting snow into the spouting. No opportunity was available for discovering whether the rabbits were suffering from a specific disease or only from the effects of starvation. It is evident, however, that if the school privy was the centre for diffusing this infection, the farmer's daughter was the first case which passed diarrhœal dejections into it, and was therefore the probable first source of its contamination. As soon as the connexion between the epidemic and the school privy was established, the latter was carefully cleaned out and chloride of lime was freely used in the process. The outbreak lasted altogether about three months.

IV. *The fourth outbreak* is more interesting than any of the others from the fact that the importation of the infection was clearly made out. Pockley is a small village of 27 houses, containing a population of 121 persons. It is situated on one of the mountainous ridges which rise from the extreme west of the Vale of Pickering, which it overlooks. Behind the village, the ridge terminates in what is known as the North-Eastern Moorlands of Yorkshire, a tract of wild, bare, and very sparsely populated country. The village is far from the beaten tracks that are traversed by tramps or "travellers." The people are entirely engaged in agriculture, and hold little communication with the outer world. The geological formation is that known as "the Middle Oolites." Rock is everywhere near the surface, and in the village it takes the form of siliceous limestone. The houses are scattered on either side of the one village street. There are five small farmhouses, and the rest of the dwellings, with the exception of the school-house, are mere cottages, mostly thatched, low roofed, and in some cases damp or dilapidated. Many of the cottagers keep a cow, and a few sell milk to their less favoured brethren. The people are healthy, hard working, thrifty, and cleanly in their habits. There is no systematic drainage. Water quickly runs off the rocky and sloping surface. The slops are generally carried by hand into the back garden and thrown to the roots of the bushes and fruit trees. There is no apparent pollution of the surface with animal refuse. The garden privies are of primitive construction. The majority of the people throw the dry ashes from the turf which they burn as fuel, over the excrement in the privy. The domestic water supplies are drawn from a series of four springs which start up in a line along the ridge on which the village is built. Except that the supply is inconvenient, having to be carried by hand to the houses, and somewhat deficient in quantity, no fault can be found with it. The locality has a reputation for healthiness, and to my knowledge had suffered less than neighbouring places from diseases of the epidemic class. No case of enteric fever has been known there within the memory of the present inhabitants: certainly during the 15 years that I practised at Helmsley no case occurred at Pockley.

On Friday, August 25, 1886, Mrs. Cooper (the wife of a peasant) and her child, aged 3, both in perfect health, went from Pockley to Leeds (at 84, Bridge Street), to visit a relation. "British cholera," the neighbours said, was then very prevalent in Leeds. It was, in fact, the customary summer epidemic of diarrhœa. On Sunday,

i.e., two days after their arrival, the child was taken ill with severe vomiting and purging. On the following Thursday (four days after the child) Mrs. Cooper was taken ill with the same symptoms. She stated that on the Wednesday night her child, who slept with her in the same bed, was very violently purged, and "messed the sheets in a dreadful way." The smell from these motions made her feel sick, and the next day her purging began. After this, the child of the relative (Mrs. Bell by name), with whom she was staying, began to have diarrhœa. The two children (viz., Cooper and Bell) generally played together in the house, and the first child (Cooper) had on several occasions passed its motions on the floor of the room in the presence of the second child (Bell). Neither Mrs. Bell, nor her husband, nor their elder child suffered from any diarrhœa at this time. On September 6th, Mrs. Cooper, feeling herself recovered, and her child being then somewhat better, left Leeds and returned to Pockley (a journey of about 60 or 70 miles). In the train, however, the child was very violently purged. They, therefore, arrived at Pockley with a number of soiled napkins. The Cooper family, in addition to the child just mentioned, consisted of two other children. In two days after the return of the mother and child from Leeds these two elder children began to be ill in the same way, viz., with abdominal pains, sickness, and diarrhœa. The youngest child also continued to be purged, but was able to run about and play with the others. It was a frequent occurrence for this child to pass its liquid motions on the cottage floor, or on an old drugget-covered sofa or "squab" upon which it took its mid-day sleep. The cottage contained only two rooms, one where the whole family slept at night, the other where they lived by day, and in which, of course, friends or neighbours sat down when they came to gossip or to inquire after the family. On Sunday, September 12th, although the two elder children of Mrs. Cooper were still suffering from diarrhœa, they attended a Methodist small Sunday school, conducted in a cottage close by. About 12 children were present, and one of these, a girl named Ashpole, developed a severe attack of diarrhœa that same (Sunday) night. There was, however, no evidence as to how this girl received the infection, if she really did receive it, from the Cooper family; and this is the only case out of the 60 which followed which could not be *clearly* traced to exposure to infection from diarrhœal discharges. During the same week three little children named Atkinson were left by their mother at Mrs. Cooper's cottage for half an hour on two separate afternoons (while she fetched her cow home from the pasture) with the result that on the night following the second visit all three children had a violent attack of diarrhœa and sickness, and a little later their father, who chiefly waited on them, had a similar attack. One day at the end of this week, Mrs. Cooper, taking her youngest child with her, walked 3 miles to see a married cousin (Mrs. Porter) who had only one child, aged about 3. Mrs. Cooper's child during the afternoon passed a liquid stool on the floor, in the presence of the other child. The same night, or in the early morning, Mrs. Porter's child had a violent attack of diarrhœa and sickness, but its mother was not affected nor anyone else in the house. Also during this same week (September 12th to 19th) a neighbour of the Cooper's, named Mrs. Coverdale, called to chat with her. While the women were gossiping, Mrs. Cooper's child again "messed" the floor. Mrs. Coverdale stated that she soon after left the cottage in consequence of the offensive smell of the stools. During the night she woke up with violent abdominal pain, and this was followed by sickness and purging. While the two elder Cooper children were convalescing, but while they were still passing, from time to time, liquid motions, they played chiefly with the children of a family named Dowkes. Two of these were taken ill a fortnight after the Cooper's began, and later the rest of the family, one after the other (viz., five children and their parents as well) had the ailment. The youngest, an infant of seven weeks old, died. The infective power of the Cooper family now became less obvious, but was apparently transferred to the Dowkes children, who seemed now responsible for many of the cases that followed. The father of the Dowkes family was away from home when the baby died, but two days after his return he was seized with the usual symptoms. He remembered the day before he was taken ill that one of his children, not then quite recovered, passed a large liquid motion into a chamber utensil in the room where he, the father, was. While the Dowkes infant was dying, two kind-hearted neighbours sat up all night with it, and assisted the mother in removing the soiled napkins. One of these neighbours (Mrs. Underwood) had a child too young to be left at home. This child therefore spent the night in Dowkes' cottage with its mother; the next day it was violently purged, and subsequently its brother as well as its mother suffered in the same way. The other neighbour was Mrs. Nicholson (the village blacksmith's wife). She also became ill next day, and within a few days her

Causation of "Diarrhœa," by Dr. Ballard.

two children, her husband, and his apprentice likewise. Mrs. Nicholson was able to use the garden privy during her attack. A neighbour of Mrs. Nicholson's named Mrs. Meggison who had no family, and who lived in a cottage which was without a privy, had permission to use that of the Nicholson's. While they were ill she also became ill with diarrhœa. She came in contact with none of the other cases but the Nicholson's. Mrs. Nicholson had some relatives in the village, and two little children came to play with their cousins (the Nicholsons) while they were ill; these two children became ill, and after them their mother. One morning a labourer's wife named Peacock and his little daughter were passing Dowkes' cottage when one of the elder children came out and threw a pot full of liquid excrement on to a dung heap close to the path. This woman and her child both felt nauseated by the foul odour, and the same evening they were simultaneously taken ill with violent sickness and purging, and in two days Mrs. Peacock's husband and two remaining children were also ill. A little companion of the youngest Peacock girl, still an invalid, came one afternoon to play with her. The sick child Peacock was suddenly purged and passed the motion on the floor to the disgust of her companion, who went home and related the circumstance to her grandmother, with whom she slept. During that night this little girl herself became very ill, and, much against her will, "messed" the sheets. Next day her grandmother also was seized with vomiting and purging.

Mrs. Dowkes sold milk to two customers. One of these was the schoolmaster named Willacey. He had two children, who had been carefully kept away from all the village children, but they also became ill at this time; the only communication was through the milk supply. The other customer was Mrs. Richardson, who had a family of four, all of whom were taken ill while the Dowkes family had the disease. In the cases of the Richardson family another explanation is possible. The Richardsons and Dowkes children were constantly together as companions, and it is quite possible that diarrhœal discharges were passed out of doors in the presence of companions. There is no delicacy about such matters among the moorland children. The Pockley school was closed for the holidays from September 2nd to October 11th. During the last week in October a group of cases occurred which seemed to owe their origin to infection caught at school. One small boy, convalescent from the disease, returned to school too soon, and unfortunately "messed his breeches" in the class-room, according to the schoolmaster's statement, and shortly afterwards at least eight of the school children, who were present in the room when this accident occurred, were taken ill. By the beginning of December there had occurred, in connexion with the village of Pockley (including those commencing the series at Leeds), altogether 62 known cases of this communicable diarrhœa.

I append a genealogical chart showing the transmission of the disease from person to person.

The chief features of this infective form of diarrhœa observed were as follows:

(1.) *Its short incubation.*—Careful inquiries showed that the average incubation period was from 10 to 12 hours.

(2.) *Its sudden invasion.*—In many cases the person retired to rest feeling perfectly well, but was awakened from his sleep by the pain and sickness as well as the feeling of impending purgation.

(3.) The leading symptoms were severe abdominal pain, vomiting, and purging, followed by great exhaustion and often fainting (in adults).

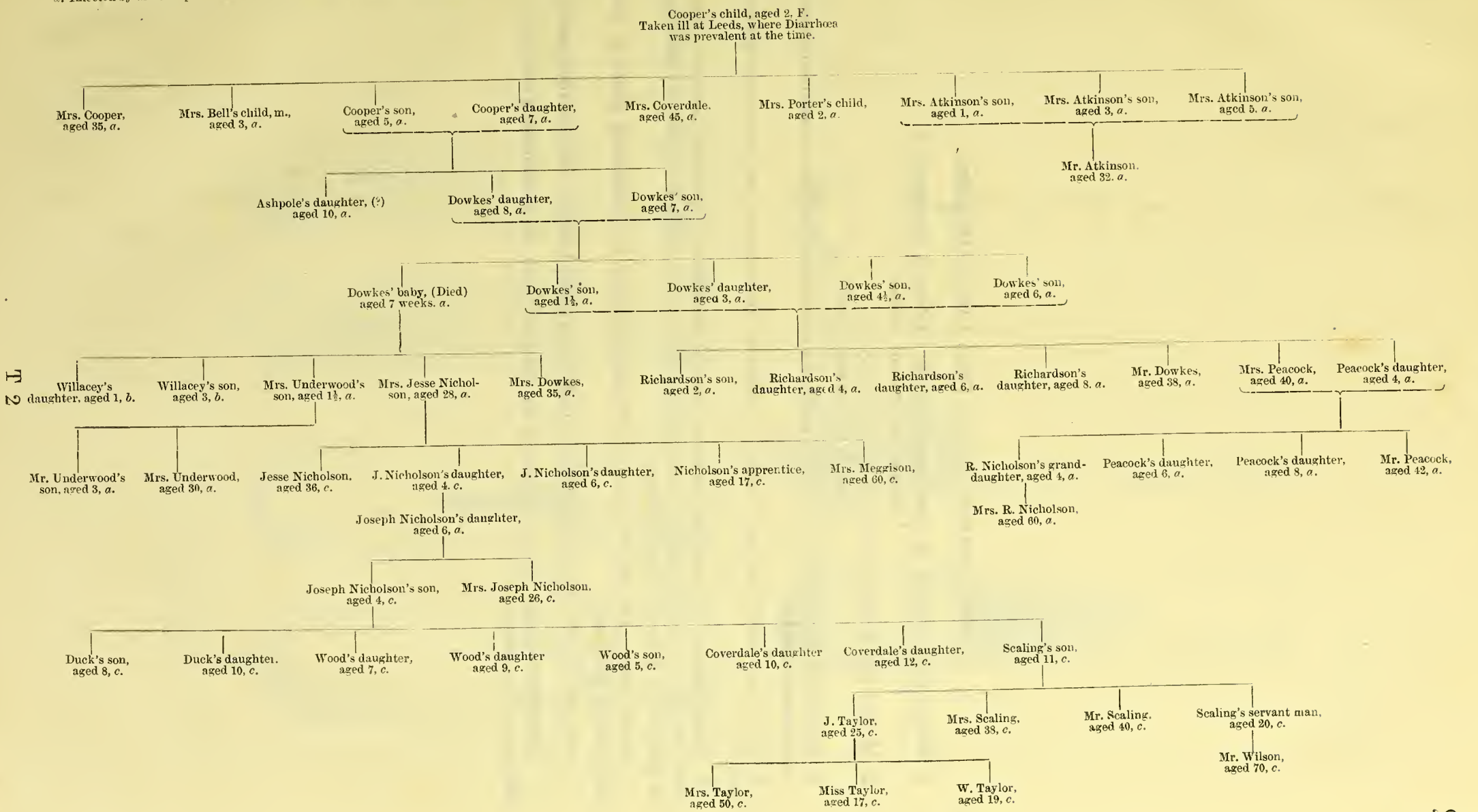
(4.) The motions were at first dark (sometimes dark green or yellow) becoming afterwards quite light coloured. Occasionally the stools contained blood. They were at first remarkably foul and offensive in odour.

(5.) The usual duration of the disease was from two to four days, but it sometimes continued longer. In some cases it lasted two or more weeks and in those cases there were often intermissions.

R. B. L.

Genealogical Chart showing Progress of Outbreak at Pockley from 1st Case to the 62nd.

a. Infected by direct exposure to fumes of recently passed infected motions. *b*. Infected by milk supplied from an infected house. *c*. Infected through emanations of privy into which infected stools had recently been passed.



T 2

Causation of "Diarrhœa," by Dr. Ballard.

Micro-organisms from a Fatal Case of Diarrhœa.

1. Bacilli from interior of a mesenteric gland. [From a subculture.]
Magnifying power, 1,400.

2. Minute bacilli from mucous flakes in the colon.
Magnifying power, 1,400.

3. Subculture *in the depth* of nutrient gelatine, of the bacillus from mesenteric gland —after several weeks.

4. Subculture *on the surface* of nutrient gelatine, of the same bacillus—after several weeks.

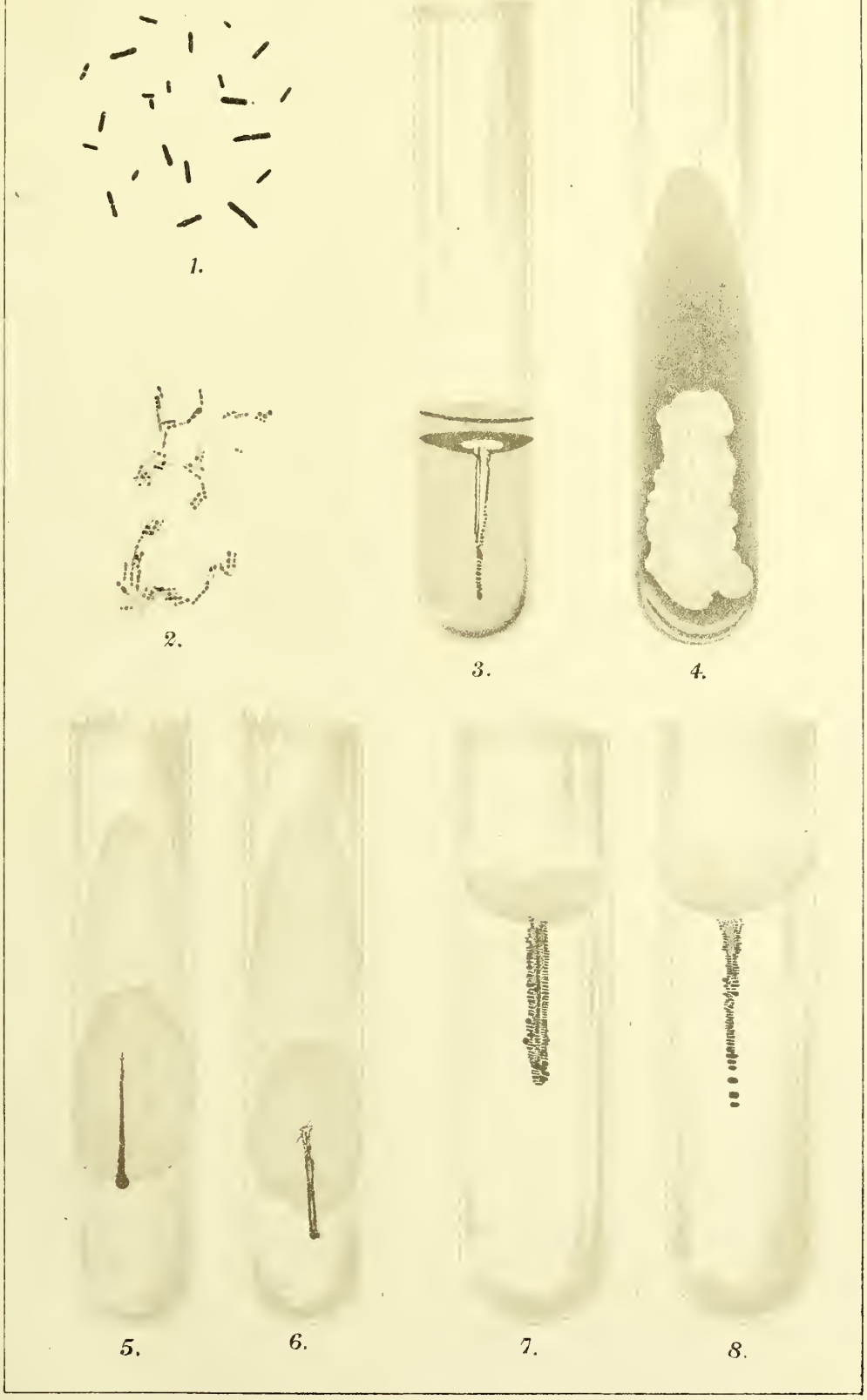
5. Subculture *on the surface* of nutrient gelatine, of Gaffky's typhoid bacillus—after several weeks. The central line is a linear growth in *the depth*, produced by stabbing the gelatine in the act of inoculation.

6. Subculture under like conditions of the bacillus from the mesenteric gland of the fatal case of diarrhœa.

7. Subculture in *the depth* of gelatine, of Gaffky's typhoid bacillus—after several weeks.

8. Subculture under like conditions of the bacilusf r om the mesenteric gland of the fatal case of diarrhœa.

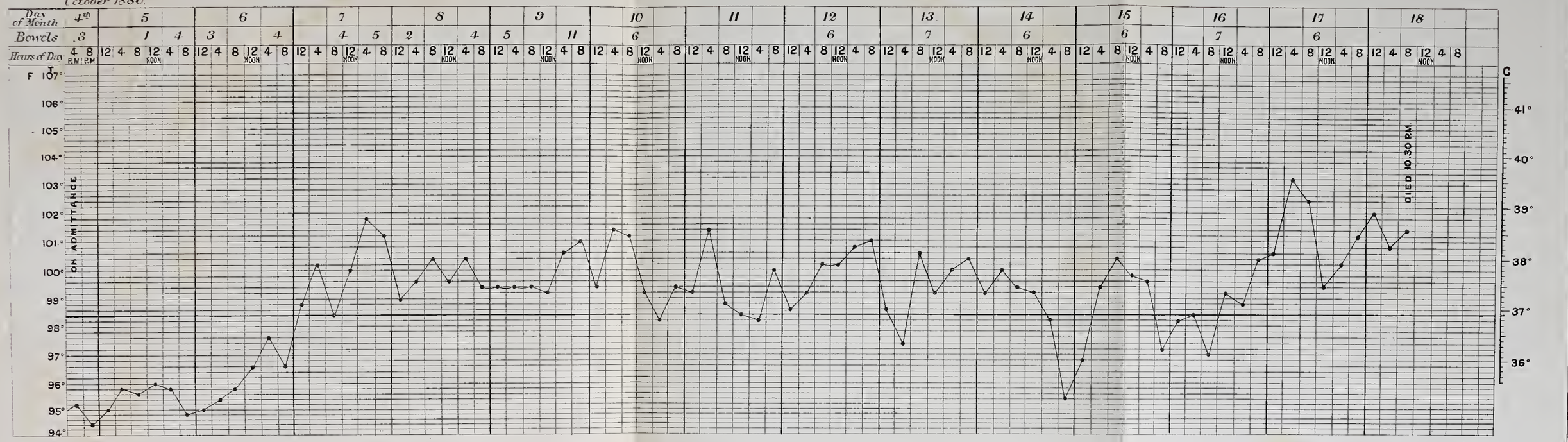
[To face page 134]



Fredk Dangerfield, Lithographer, London. 16261.

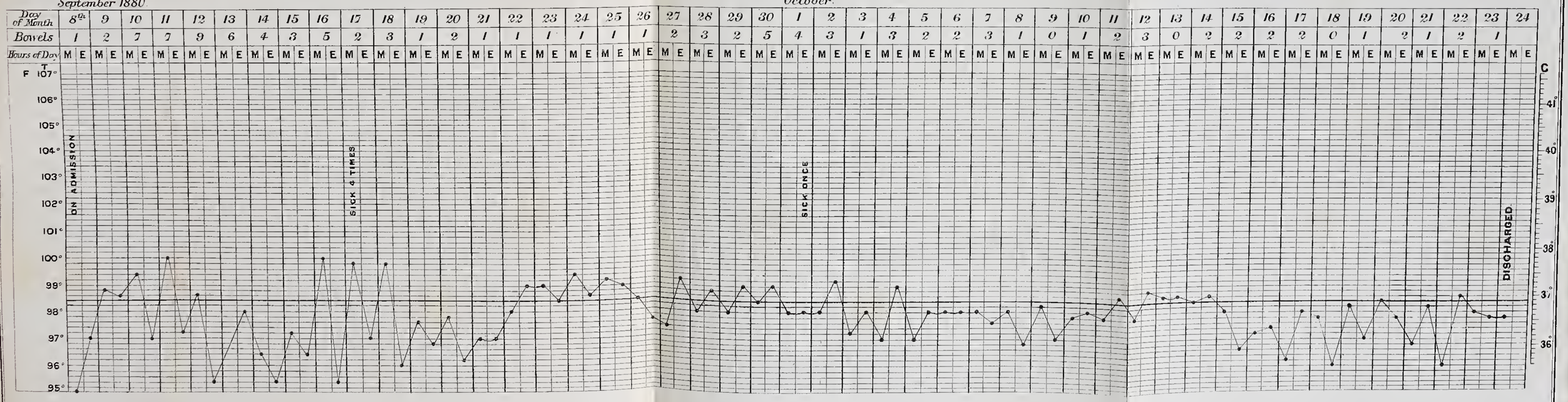
CASE XV. P. 89.

Name E.D. Age 4 yrs 9 m ths Disease: Marasmus, Diarrhœa.



CASE XVIII. P. 90.

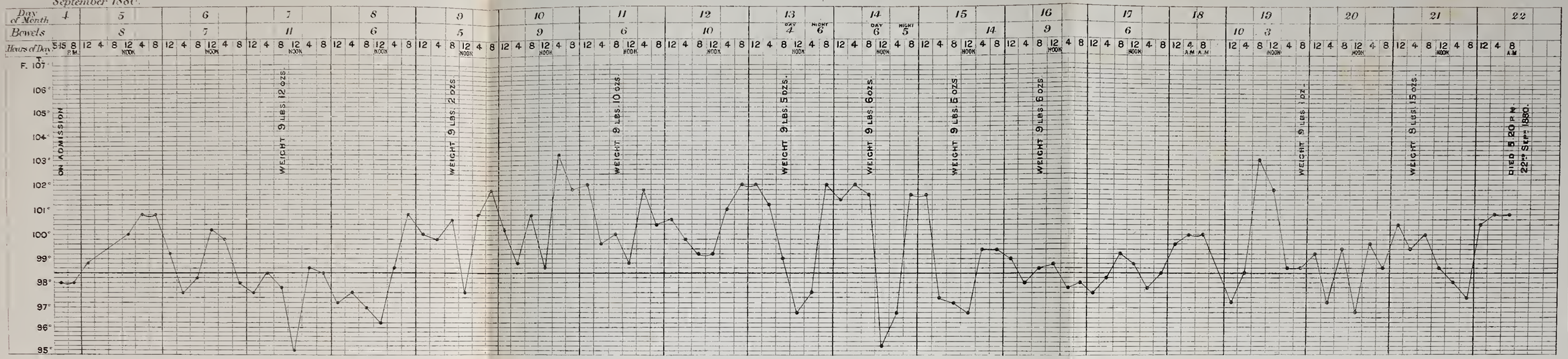
Name M.R. Age 1 y. 9 m ths Disease: Rickets, Diarrhœa.



DANGERFIELD, LITH. 21 BEDFORD ST COVENT GARDEN 16632(6.88)

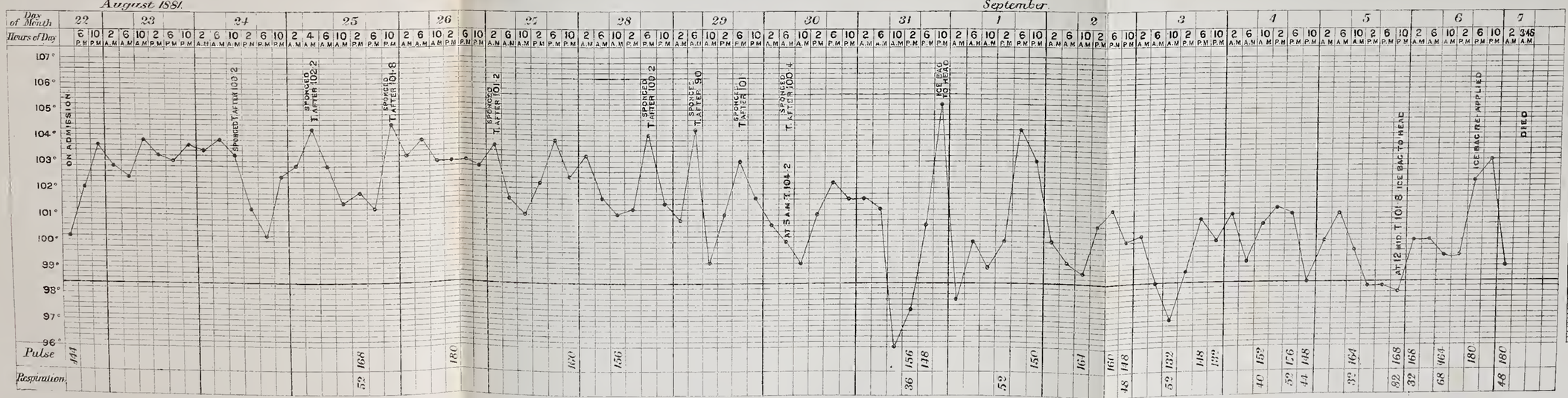
Case XVI. p. 90.

Name M.L. Age 10 mths Disease Diarrhœa.

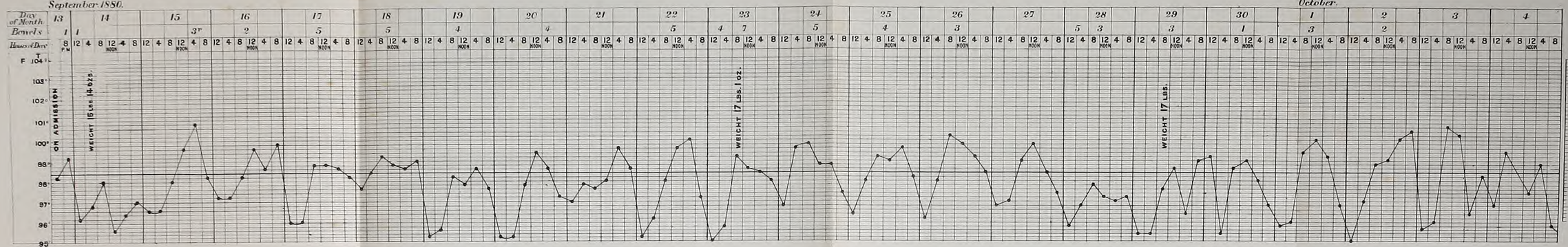


Case VI. p. 81.

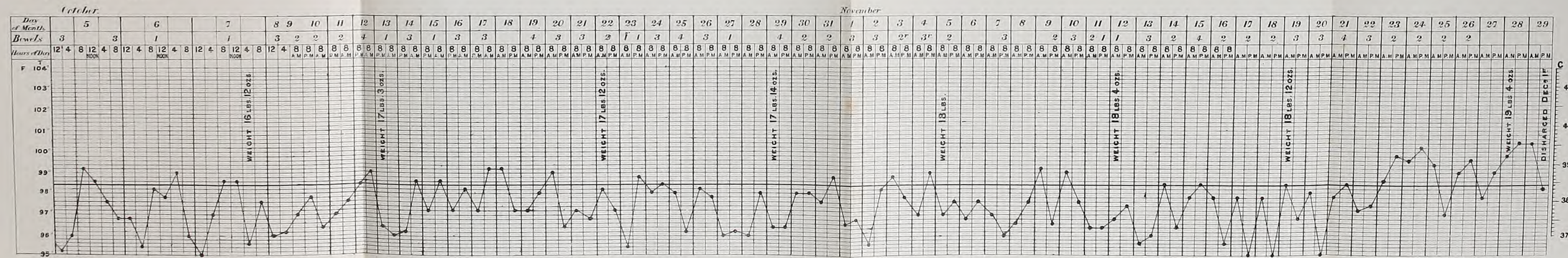
Name J.M. Age 4 mths Disease Acute Diarrhœa. (Double Pneumonia)



Name W.C. Age 1yr 8 mths Disease: Diarrhœa.

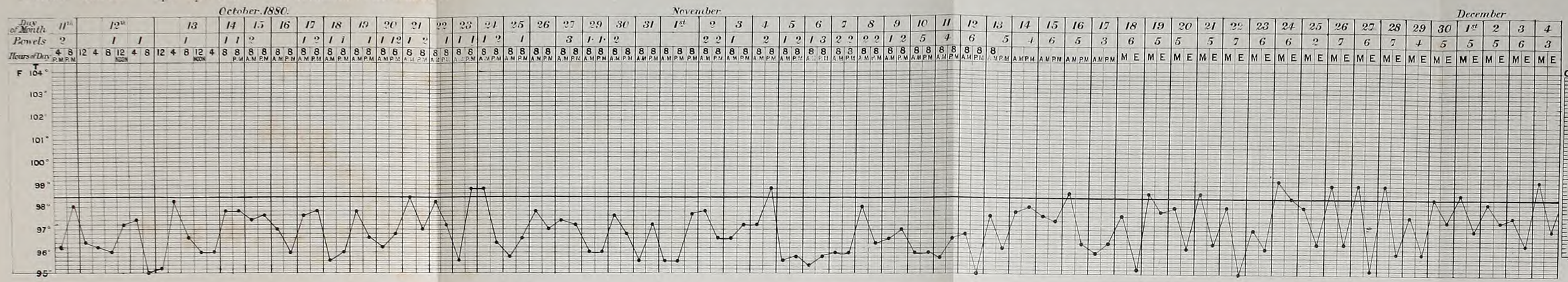


Case W.C. cont'd

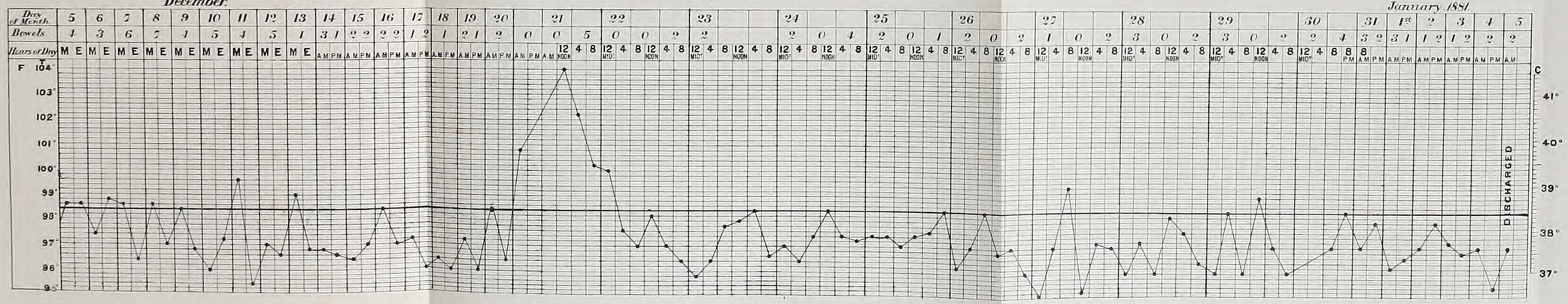


Dangerfield Lith. 22 Bedford St. Covent Garden 164/4.6.80

Name R.G. Age 1yr 3mths Disease: Marasmus.



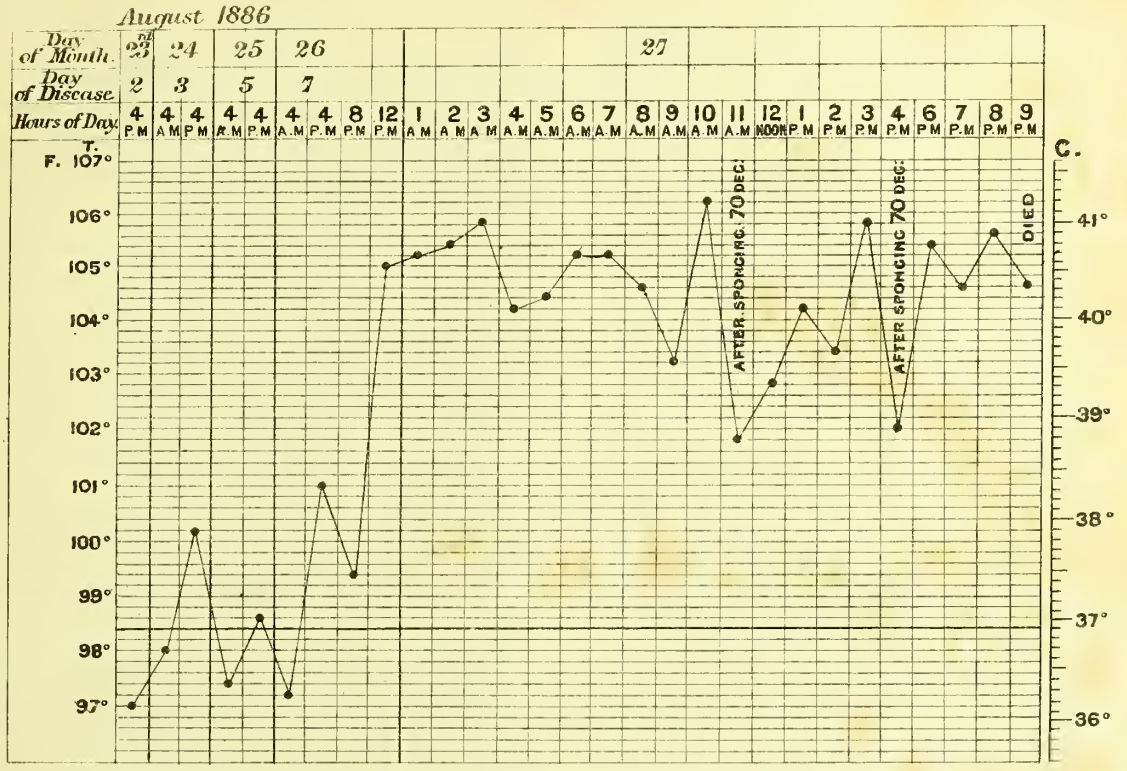
Case R.G. cont^d



Dangerfield Lith. 22 Bedford St. Covent Garden. (64/.. 6.88)

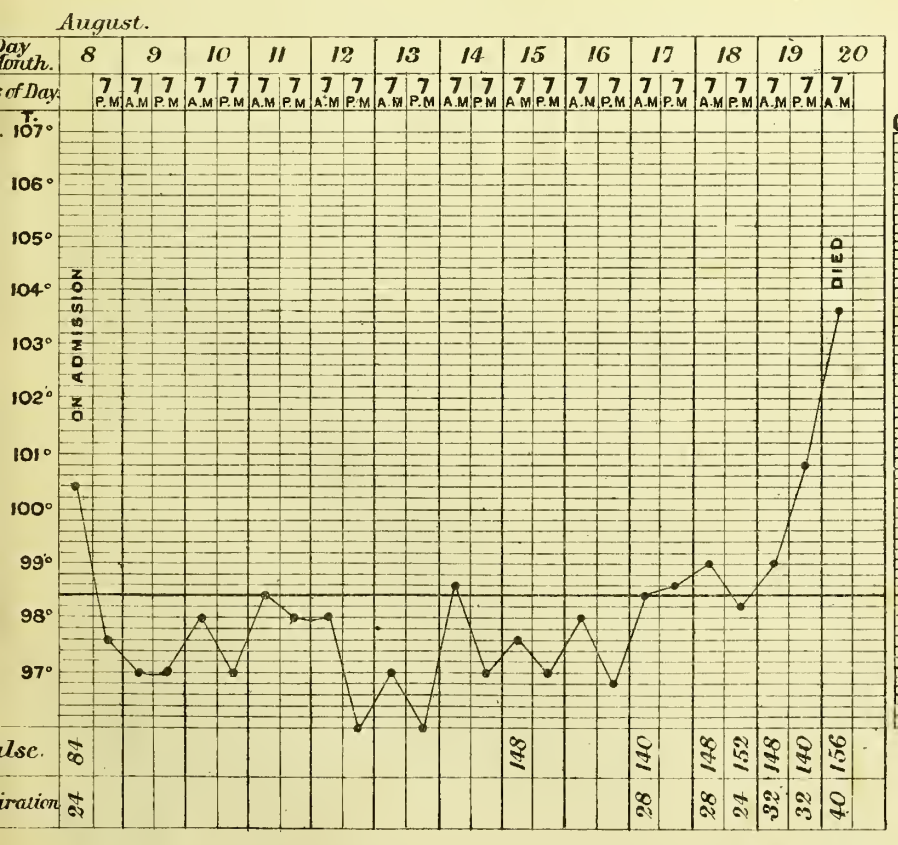
Case XXV. p. 92.

Name E.B. Age 6 mths Disease: Acute Diarrhœa, Meningitis.



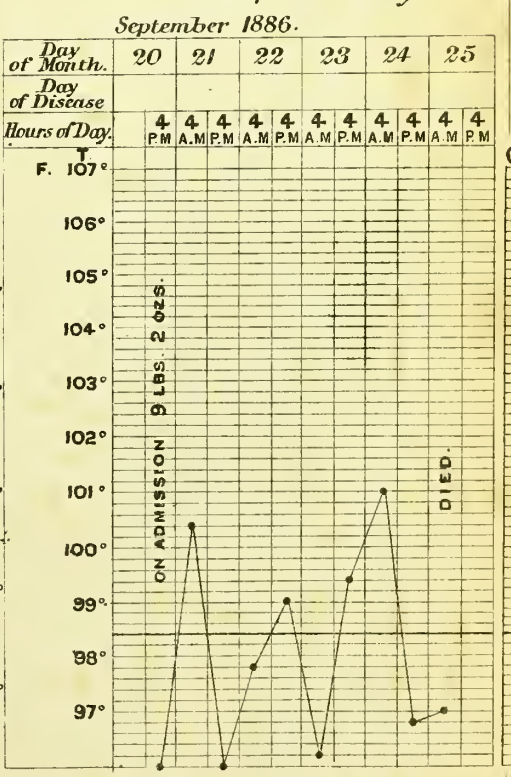
Case V. p. 80.

Name D.E.M. Age 1 yr. 3 mths Disease: Diarrhœa & Wasting.



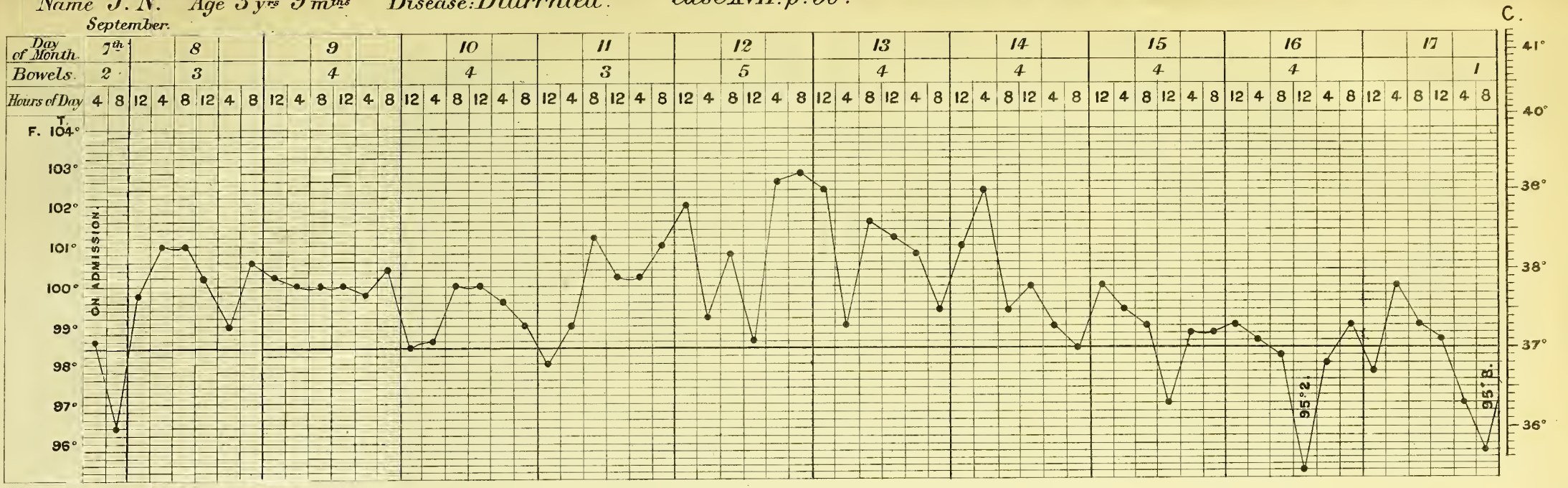
Case XXII. p. 91.

Name J.W.F. Age 12 mths Disease: Diarrhœa. Wasting, Collapsed Lungs.

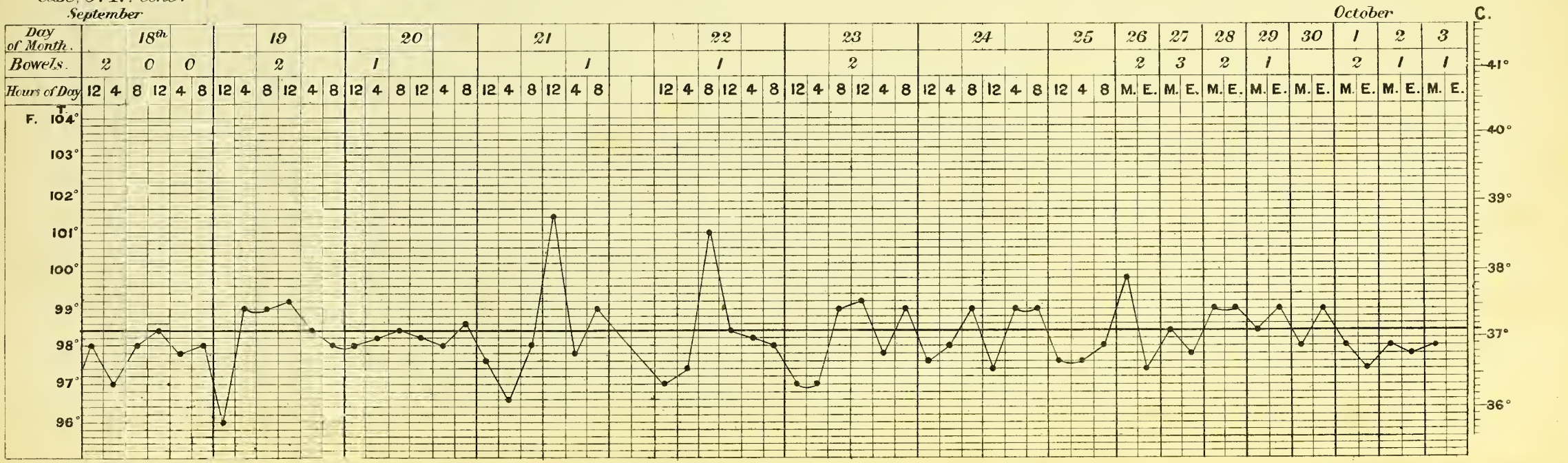


Name J. N. Age 3 yrs 9 mths Disease: Diarrhœa. Case XVII. p. 90.

To face p. 134.



Case, J. N. contd



Dangerfield Lith 22, Bedford St Covent Garden 16623/6.88

The Geographical Distribution of Diphtheria in England and Wales; by G. B. Longstaff, M.B.

Introduction.

In spite of the immense labour and great ability that have been for a long time devoted to the subject, the etiology of diphtheria is still very obscure. A faint hope of lighting upon some clue has induced me to undertake a tedious investigation into the geographical distribution of 89,603 deaths from the disease recorded in England and Wales during the 26 years from 1855, when it first appears in the returns of the Registrar General, to the close of 1880.

The influence of age and sex on diphtheria, so far at least as it is a fatal malady, is peculiar.

TABLE I.

	Diphtheria Deaths. England and Wales.		
	Males.	Females.	Persons.
1855–60	9,844	10,879	20,723
1861–70	18,467	20,987	39,454
1871–80	13,815	15,611	26,426
Total -	42,126	47,477	89,603

TABLE II.

	Diphtheria Deaths. Females to 1,000 Males.	Persons living. Females to 1,000 Males.
1855–60	1,105	1,047
1861–70	1,136	1,053
1871–80	1,130	1,054
Average -	1,124	1,051

The facts as to sex are set forth in Tables I. and II. from which we learn that more females die than males by about 12 per cent., whereas the number of females living exceeds that of males by 5 per cent., so that an excess amounting to 7 per cent. remains, which cannot be accounted for by the disparity of the sexes in the general population.

Table III.* gives for each sex the number of deaths at several groups of ages, and from it we learn that 57 per cent. of the deaths of males and 51 per cent. of the deaths of females occur in the first five years of life; in the next five years 25 and 29 per cent. respectively, while after the forty-fifth year is reached only $2\frac{1}{2}$ per cent. of the deaths of males and 2 per cent. of the deaths of females take place.

This table also shows that the excessive number of female deaths occur mainly between the fifth and fifteenth years of age; indeed after the age of 45 slightly more males than females die of diphtheria.

In Table IV. the death-rates per million living at each age are given, and from the figures we see that not only absolutely, but relatively to the numbers of each sex living, the excess of deaths of females is mainly between the ages of five and fifteen. This excess, however, does not seem to me to be sufficiently marked for any irregularities in age or sex distribution to seriously affect the figures as to geographical distribution that I am about to lay before you.

A few words as to the death-rates in the first five years of life generally. For the first period the materials are not given in the returns. In the remaining 20 years

* Tables III. to XV. are printed at the end of this paper.

several considerable discrepancies between males and females are apparent, but I do not care to lay stress on these since the ages given in the census are notoriously uncertain for these early years. The mortality is, however, without doubt least in the first year, thus offering a marked contrast to summer diarrhœa; for the next four years it is, roughly speaking, constant, and during these years (second—fifth) no less than 47 per cent. of the deaths of males and 45 per cent. of the deaths of females take place.

I should say that nearly all the figures quoted are obtained from the supplements to the 25th, 35th, and 45th Annual Reports of the Registrar General, but in a few cases it has been necessary to refer to Annual Reports themselves or to the Census. Also to two Parliamentary Papers known as "Mr. Lowe's Returns," 1864 and 1873. The populations given are the means of successive censuses, and are in most cases taken direct from the decennial supplements. As the diphtheria deaths are in the first period only for the six years 1855-60, whereas the populations are the means of the two censuses for 1851 and 1861 it follows that the latter are too small and the death-rates calculated from them consequently too large; the error affects all districts more or less, but mainly those in which the population is increasing very rapidly. The mean error in the population thus arising amounts to 22 in every 1,000. Thus for England and Wales I have given the death-rate for the six years as 182; it should be only 178. In some few instances this might affect the argument slightly, but the error such as it is, must remain, since the labour of recalculating all the populations is more than I am inclined to face. Moreover, the assumption of the decennial supplement, that the population may be taken as the arithmetical mean of two successive censuses, itself overstates the population of rapidly growing districts, since the growth is in a geometrical and not an arithmetical progression.

To avoid overloading the paper with tables I have thought it best to omit areas, populations, and deaths, only giving densities of population and death-rates.

Registration divisions.

In examining the geographical distribution of the deaths from diphtheria I shall begin with the eleven registration divisions into which England and Wales are divided.

The registration divisions are large areas, most of them comprising several counties. In the second period under review the smallest of them, the Eastern Division, made up of the counties of Essex, Suffolk, and Norfolk, contained a population of 1,180,655 persons, of whom 3,493 died of diphtheria, while the largest of them, the North Western, comprising the counties of Cheshire and Lancashire, contained a mean population of 3,159,406 of whom 5,442 died of diphtheria in the decennium. It is therefore obvious that the argument concerning the fallaciousness of small numbers does not apply here at any rate.

In Table V. the registration divisions are arranged in the order of their diphtheria death-rates per 1,000,000 persons living for each of the three periods under review.

In Table VI. the whole period of twenty-six years is taken and the registration divisions are arranged, (1.) in the order of their mean annual death-rates from diphtheria; (2.) in order of their density of population; and (3.) in order of their mean annual death-rates from all causes. In columns (1.) and (3.) the death-rate of England and Wales is taken as 100, so that the excess of each division is read off at once in per-centages of the mean.

An examination of these tables shows that the South-Western, South Midland, and Northern Divisions have always experienced a *low* diphtheria mortality. Again the North-Western, and to less marked degree the London Division have suffered little on the whole, but in the third period each of them exhibited a slightly higher death-rate than in England and Wales. It will be noted that the London and North-Western Divisions (this last comprising Cheshire and Lancashire) are by far the most densely populated, and they also have the highest general death-rate, the North-Western Division enjoying a most unenviable notoriety in this respect.

On the other hand diphtheria is seen to have been *above* the average of England and Wales in each period in the West Midland and South-Eastern Divisions; also in two out of the three periods it has been above the average in the Welsh and Eastern Divisions, and has in no case fallen much below the average in those divisions. The North Midland Division, although on the whole it has suffered most of all, has been affected very irregularly. Now all these five divisions have a general death-rate below the average. In point of density of population they vary considerably. The Eastern and Welsh Divisions have a population mainly rural; that of the South-Eastern Division is about half and half; that of the North Midland Division is more rural than urban, but in the West Midland Division urban conditions predominate.

So far as we have gone it would appear that rural life is not unfavourable to fatal diphtheria, while on the other hand the disease shows no special proclivity for densely populated districts. A comparison of columns (2.) and (3.) of Table VI. shows that, as is well known, it is far otherwise when deaths from all causes are considered.

This seemingly undue incidence of diphtheria on sparse populations I shall proceed to investigate in some detail.

Counties.

By breaking up the divisions into their component registration counties, we shall get much more specialised populations to deal with, but at the same time as the numbers fall the results deduced may be less trustworthy. With a view to partially obviating fallacies due to small numbers I have made the following adjustments:—

Huntingdonshire (population * 58,592) has been added to Cambridgeshire.

Rutlandshire (population 23,432) has been added to Leicestershire.

Yorkshire has been divided into its three ridings, as their characteristics are so different.

Westmoreland (population 63,038) has been added to Cumberland, together with the Ulverston district of Lancashire (including Barrow-in-Furness), the whole making a natural group which I have termed "the Lake District."

Wales I have divided into—

1. Glamorganshire (population 366,026).
2. The remainder of South Wales.
3. North Wales.

It will be noted that the object has been to group together districts having similar characteristics. As thus adjusted, the smallest country (Hereford) has a population of 107,726, while five other countries range up to Hertford with 186,032. At the other extreme, Lancashire has 2,657,312.

In Table VII. the registration counties (modified as above) are arranged, for the three periods severally, in the order of their diphtheria death-rates; England and Wales being taken as having a death-rate of 100.

In Table VIII., the same counties are arranged in parallel columns in the order of (1.) Diphtheria death-rates for 26 years; (2.) Mean density of population, 30 years; (3.) General death-rates, 30 years. Where the diphtheria rate of a county has been above (or below) the average of England and Wales *in each of the three periods*, it is printed in italics.

It will be seen from these tables that of the 12 counties which have uniformly suffered *less* from diphtheria than the average of England and Wales, four are counties with dense populations, including indeed Metropolitan-Middlesex and Lancashire. On the other hand, of the seven counties which have uniformly suffered *more* than the average from diphtheria, only two (both suburban) have somewhat dense populations, while one (South Wales, except Glamorganshire) is the most thinly populated of all.

Looking at the matter in another way, there are seven especially densely populated counties, three of which, Lancashire, West York, and Metropolitan-Middlesex, suffer from the highest general death-rates; Metropolitan-Surrey and Warwick also have high death-rates, Metropolitan-Kent an average, and extra-Metropolitan-Middlesex, alone of the seven, a low death-rate. But as regards diphtheria, three of these, viz., Metropolitan-Middlesex, West York, and Lancashire (the last particularly) have enjoyed comparative immunity from the disease in all three periods; two of them, Metropolitan-Surrey and extra-Metropolitan-Middlesex, have enjoyed like immunity in two periods out of three, while two only have twice suffered more than the average of England and Wales, namely, Metropolitan-Kent and Warwick, the last very severely.

Of 12 counties standing at the other end of the list as districts of especially sparse population we find:—

Three counties above the average for diphtheria in each period, viz., Shropshire, Lincolnshire, and South Wales (less Glamorgan); five counties above the average twice out of three times, viz., Norfolk, North Wales, North York, and Hereford (all of which suffered very severely in one or other period), and Northumberland.

On the other hand, Wiltshire, Dorsetshire, and Cambridge (with Huntingdon) suffered more than the average in but one period; Cambridge very severely. The Lake District, one of the least dense "counties," had a mortality somewhat below the average throughout.

In the map the counties are tinted so that the depth of colour is proportional to the mortality from diphtheria. The contrasts between Lancashire and the West Riding,

* These are the mean populations of the middle period (1861–70).

Geography of Diphtheria, by Dr. Longstaff.

when compared with the sparsely populated adjoining counties; London and the home counties; Glamorganshire and the rest of South Wales; as also the remarkable prevalence of diphtheria in the Eastern Counties and Wales are very strikingly indicated.

At this point we may safely say that density of population is not a factor of prime importance in the production of fatal diphtheria, indeed on the contrary I hope to be able to show in the sequel that this disease has a strong predilection for scattered rural populations, and even for districts reputed to be exceptionally healthy.

Registration districts.

Having got so far it is obviously desirable to compare, if it be possible, the relative mortality from diphtheria of town and country districts *within the same county*. The easiest way of doing this is to lay down definitions of what are to be considered densely populated, medium, and sparsely populated districts respectively, and then examine the several counties and the districts of which they are made up.

The criteria that have seemed to me best are the following, viz.:—

1. *Dense Districts.*—Those in which there is less than one acre to each person living. Practically these comprise all the very large towns, together with a few small ones.

2. *Medium Districts.*—Those in which there is one acre to each person living, but less than two acres. This class comprises a large number of unions containing medium sized towns.

3. *Sparse Districts.*—Those in which there are upwards of two acres to each person. In these there are but few towns of any size, and even where considerable country towns are included, their population bears but a small proportion to that living outside under strictly rural conditions.

As the populations are very different in the different periods, and the areas themselves are by no means fixed, it is only possible to compare districts for each decennial period separately. Where changes of area have been made during the decennial period, I have made such adjustments as seemed possible, and, although the results for the districts involved are necessarily inaccurate, I feel pretty sure that the discrepancies are not sufficiently numerous or important to materially affect the argument. It is fair to state that the following comparisons involved very considerable labour in the calculations of area, populations, and rates.

In Table IX. are given for the six years 1855–60, for each registration county the population of its dense, medium, and sparse districts, together with their death-rates per million persons living. It will be seen that, as might have been expected, there are several counties which do not contain any registration districts falling under each of the three above defined descriptions, for instance, all the registration districts within the metropolis come under our definition of "dense districts," whereas those in Herefordshire are all "sparse districts."

There are, however, 25 counties in which we can compare dense districts with medium districts, and in no less than 20 of these the diphtheria mortality was higher in the medium than in the dense districts.

Again, there are 32 counties in which we can compare medium with sparsely-populated districts, and it will be seen that in 28 of these the sparse districts suffered more severely from diphtheria than the others.

Lastly, there are 29 counties in which it is possible to compare dense districts with sparse, with the result that in no less than 26 the sparse districts suffered most.

There are, moreover, three counties having only dense districts, all with but moderate diphtheria mortality, and four with only sparse districts, which all suffered very severely.

The figures for the whole of England and Wales for this period are: dense districts 123, medium districts 182, sparse districts 248 diphtheria deaths per million persons living.

It is therefore plain that so far as the first period is concerned, diphtheria showed itself to be twice as fatal a malady in rural districts as in large towns, while districts with medium density of population occupied a middle position.

In the second period (Table X.) the results are less striking: thus, we see that for all England and Wales the death-rates for dense, medium, and sparse districts are 163, 164, and 223 per million living respectively.

Out of 28 counties in which it is possible to compare dense with medium districts, in 21 instances the medium districts have the higher diphtheria mortality.

Out of 33 counties in which medium districts can be compared with sparse, there are 24 in which the mortality in the sparse districts is greater.

Out of 31 counties in which dense districts can be compared with sparse, there are 25 cases in which the mortality in the sparse districts is greater.

AVERAGE DIPHTHERIA DEATH RATES.

Twenty six years 1855–80.

(ENGLAND & WALES TAKEN AS 100)

54-79 | 82-88 | 92-109 | 116-141 | 149-191

DANCERFIELD LITH 22, BEDFORD ST COVENT GARDEN 15940 3/88

Geography of Diphtheria, by Dr. Longstaff.

Lastly, in the case of seven counties in which the foreging comparisons are not possible, and for which the method of comparison with the rate of the whole country is made use of, the influence of density and sparseness was not so uniform as in the first period; in two of the three dense (metropolitan) districts the mortality was *above* the average of the whole country, and in one of the counties with only sparse districts, the mortality was *below* that average, though the other three sparse counties suffered very severely.

In the third period (Table XI.) the results are similar to those in the second period, but still less marked. The death-rates for England and Wales are 114, 125, and 132. for the dense, medium, and sparse districts respectively.

Out of 29 counties in which dense and medium districts can be compared, the medium districts have the higher death-rate in 15 cases only.

Out of 34 counties in which medium and sparse districts can be compared, the sparse districts have the higher death-rate in 21 cases.

Out of 31 counties in which dense districts can be compared with sparse, the sparse districts have the higher death-rate in 23 cases.

Lastly, as regards the five cases in which no comparisons are possible, the dense districts and sparse suffer equally.

Density of population.

If we assume the mortality of the dense districts as 100 and take the average of the three periods, we get a sufficiently striking result:

Mortality from diphtheria in dense districts - -	100
,, ,, medium ,, - -	118
,, ,, sparse ,, - - -	151

It is, however, not easy to conjecture why in each succeeding decade the towns should have, relatively to the rural districts, suffered more and more. If we grant for a moment the exciting cause of the disease to have its origin in the country, it is just possible that the constantly increasing communication between town and country, by affording additional opportunities of importing the disease, might account for its increased prevalence in towns. Although the greater proximity of people in towns would at first sight seem to greatly increase the chances of infection, it is by no means certain that the individuals of a town community come so much into personal contact as the dwellers in a lonely hamlet. There may be but few opportunities for the introduction of the poison into an isolated village, but once introduced there are great facilities for its spread; in a village every one knows his neighbours, whereas in a large town dwellers in the same street are often complete strangers to each other. But facility of communication, or the reverse, cannot be the true explanation, since other communicable diseases, such as measles, scarlatina, and whooping-cough are most fatal in towns. It would, of course, greatly facilitate the investigation if there were statistics of *cases* of disease available, whereas it is only possible to discuss deaths.

I have been anxious to avoid the charge of dealing with numbers too small to give trustworthy results; hence, instead of dealing with individual registration districts, I have grouped them together as far as possible, and then have drawn my inferences from the comparisons of numbers of these groups. It would obviously be most unsafe to attempt to argue from single instances in which some single special circumstance might altogether outweigh general considerations. But in order to be able to form a more definite idea of the sort of localities which are either specially liable to diphtheria, or enjoy an unusual immunity therefrom, I have compared the diphtheria death-rate of every registration district, in each of the three periods, with that of England and Wales, and divided the districts into the four following classes:—

Fluctuations of incidence.

Class A. Diphtheria mortality 50 per cent. and upwards above that of England and Wales.

Class B. ,, ,, above that of England and Wales, but not 50 per cent. above it.

Class C. ,, ,, below that of England and Wales, but not 50 per cent. below it.

Class D. ,, ,, at least 50 per cent. below that of England and Wales.

For my purpose it is obviously of little importance to take note of occasional prevalences of, or occasional exemptions from, diphtheria. Therefore, I give in Table XII. those registration districts which were in all three periods greater sufferers from diphtheria than the average of the whole country, indicating the severity of the disease more precisely according as they fell under Class A., in one, two, or all three periods, or not at all. Similarly, the districts whose mortality was always below the

Geography of Diphtheria, by Dr. Longstaff.

average are given in Table XIII. classed according to the number of times that they came under Class D. In these tables dense districts are printed in SMALL CAPITALS and medium districts in *italics*.

It will be noted that there are 80 districts in which the diphtheria mortality has been uniformly above that of England and Wales. Classed according to density of population only three of these are dense (one a metropolitan district and two in the suburbs of Birmingham), six are medium, but as many as 71 are sparse districts.

In Table XIII. are shown the 140 districts in which the diphtheria mortality was uniformly below that of England and Wales. Classed according to density of population no fewer than 51 of these were dense districts and 26 medium, whereas only 63 were sparse.

It can scarcely be denied that the last two tables show in a remarkable way that very many of the largest towns of the country have suffered comparatively little from diphtheria. Indeed, that will be found to be the case with districts comprising the whole or parts of one-half the great towns of England; among them, towns with such an evil sanitary reputation as Hull, Leeds, Bolton, Newcastle-on-Tyne, Leicester, Manchester Liverpool, and East London. On the other hand, in parts only of three of the large towns (London (Islington), Birmingham, and Brighton) has there been continuous excessive diphtheria mortality.

I am not prepared to point out any special characteristics which the places that have suffered most from diphtheria have in common, further than that the great majority of them are poor law unions whose populations live mainly in scattered villages or in country towns of small size. Of the 80 districts, 12 are in Sussex, 7 in extra-metropolitan Kent, 7 in Lincolnshire, 7 in South Wales, 5 in extra-metropolitan Surrey, and 4 each in Shropshire, West York, and East York, leaving only 30 districts for all the rest of the country.

To check these results, and with a view to partially eliminating the effects of communication of infection, I have prepared Table XIV., in which are given the registration districts whose diphtheria mortality has always exceeded that of the *county in which they are situated;* also Table XV. in like manner, *mutatis mutandis*, for districts of low mortality.

There were 82 which persistently suffered from diphtheria beyond the average of their counties, of which 10 were dense, 8 were medium, and 64 sparse. On the other hand there were 120 districts which persistently suffered less than the average of their counties; of these, 46 were dense, 19 medium, and 55 sparse.

These tables then tell the same tale as Tables XII. and XIII., only somewhat less emphatically.

As might have been expected very many districts appear in both lists. Thus out of the 80 districts that suffered severely in comparison with the whole country, 47 also suffered severely when compared with their own counties.

Again, of the 140 districts, that, as compared with the whole country, enjoyed comparative immunity, as many as 85 enjoyed a like immunity when compared with their respective counties.

Persistence of incidence.

Taking both standards together the districts* which suffered most from diphtheria during the 26 years were:—

(1.) Tenterden, Chelmsford, Ellesmere, Horncastle, Howden, Driffield, Aberayron.

All of these are very sparsely populated unions.

(2.) The following suffered only slightly less: Peterborough, Smallburgh, Gainsborough, Rothbury, and Haverfordwest.

All of which again are sparsely populated.

(3.) Next after these came: Bridge, Hailsham, Petersfield, Witham, Blything, Sturminster, Ledbury, Penkridge, ASTON, Solihull, E. Retford, Selby, Patrington, Morpeth, Cardigan, Lampeter, and Crickhowell.

Of these Aston is a dense district, but all the others are sparse, and, moreover, with the exception of Crickhowell, they all, during the 30 years 1851–80, enjoyed a general death-rate below that of England and Wales.

Per contra those districts which have enjoyed the greatest immunity, both when compared with their counties and with England and Wales, are—

(1.) SOUTHAMPTON, BOLTON, and Machynlleth.

(2.) Only slightly less favoured,—

Hoo, *Uxbridge*, Bicester, Halstead, Chard, *Yeovil*, *Nuneaton*, Blaby, WIGAN, and HALIFAX.

---

* Districts of medium population in *italics*; of dense population in SMALL CAPITALS.

(3.) Distinctly worse than the preceding, but still notably healthy as regards diphtheria are,—

Farnham, Fordingbridge, Andover, *St. Albans*, Amersham, Newport Pagnell, Brixworth, Helston, Leigh, Settle, Keighley, Houghton-le-Spring, *Chester-le-Street*, Cockermouth, Llanelly, and Pembroke.

As regards density of population, out of the above 29 districts, seven take rank as dense, and six as medium, while 11 had a general death-rate above that of England and Wales, the three Lancashire towns, Wigan, Bolton, and Leigh being the worst.

It may be remarked incidentally that there is no registration district, however small, which has escaped from fatal diphtheria for longer than one of the three periods. The smallest actual number of deaths registered in the 26 years was four in Hoo, a a Kentish district of 3,043 inhabitants, which gives a death-rate of 54 per million living. The 13 districts in column (4) Table XIII. had mean diphtheria death-rates ranging from 42 to 69 per million, against 159 for England and Wales.

To sum up, whatever units of area are taken in the examination of the geographical distribution of diphtheria in England and Wales the same general results are arrived at. The distribution of diphtheria is apparently *sui generis*, the mortality from the disease clearly is not regulated by the same causes as influence the general mortality, certainly density of population does not favour it. This disease appears rather to have a preference for certain special districts, the great majority of which may be described as rural, and which have but a small proportion of their people living in towns; indeed, several of these districts, notably, Rothbury, Solihull, Hailsham, Petersfield, Ledbury, and Tenterden have such a very low general death-rate (varying from 15·3 to 17·7 per thousand) that they may fairly claim to be amongst the healthiest areas in England. On the other hand, whilst among those districts which have to a great degree escaped the ravages of diphtheria, there are some notably healthy areas, such as Farnham and Andover (with death-rates of 16·7 and 17·7), there are also a number of towns of medium or large size, some of which such as Leigh, Bolton, and Wigan have high general death-rates (ranging from 23·5 to 27·1).

Some one will object, "you have yourself stated that the incidence of diphtheria "mortality according to age and sex is peculiar, and yet in your argument you make "no allowance for differences in the age and sex constitution in the populations of the "districts." This is quite true, but it should also be remembered that four-fifths of the whole of the deaths from diphtheria occur among children under 10 years of age, and an extremely small proportion among elderly persons. Now it is a well-known fact that in densely populated districts the proportion of children is larger and the proportion of elderly persons notably less than in rural districts. If, therefore, it were worth while to undertake the immense labour of correcting all my calculations for differences of "age and sex constitution," the striking contrast that I have endeavoured to bring out between the liability of rural and urban populations to fatal diphtheria would be *still more marked.*

Again, the geographical distribution of the other zymotic diseases is totally different to that of diphtheria. That summer diarrhœa is especially a disease of towns is a familiar fact to which attention has repeatedly been called by the Registrar-General. Measles is especially fatal in London.* Scarlet fever is most common in the mining and manufacturing counties — Durham, Yorkshire, Northumberland, Staffordshire, Warwickshire, Cheshire, Lancashire, Monmouthshire, and South Wales.†

[The practical deduction suggested by these facts is, that the cause, or causes, of diphtheria should not be sought for primarily in any high development of civilization, such as sewers, but rather in some condition associated with a more primitive mode of life. Again, privies and ash-pits can hardly be important agents in breeding or disseminating the disease, or we should expect to find diphtheria exceptionally prevalent in those northern towns where such nuisances reach their worst, whereas the contrary is the case. On the other hand, low vegetable organisms developed in damp dwellings would perhaps fit in with the facts that I have brought forward; or again, some evil special to shallow wells or other primitive sources of water supply. The line of investigation, however, which seems to me most promising lies in comparative pathology. The peasantry live on terms of great intimacy with domestic animals, more particularly cows, sheep, pigs, and poultry (including pigeons). Some little known disease of some one or other of these creatures may be capable of inducing in men or women brought into frequent and close contact with them a trivial "mem-

* Forty-seventh Annual Report of Registrar-General, p. xiv.
† *Ibid*, p. xiii. See also Note at end of this Paper.

Geography of Diphtheria, by Dr. Longstaff.

branous sore throat;" then, under suitable conditions of recipient and environment, the more generally recognised form of the disease "true diphtheria," or as it used to be called "cynanche maligna" may result. The poison, perhaps gathering intensity and infectiveness, may then be conveyed into towns by farm produce such as milk, cream, or poultry, conceivably by eggs, meat, or vegetables; and lastly through the persons first infected, the sources of water supply, or the public sewers may get poisoned, and so indirectly aid in the spread of the disease. But these speculations are taking me beyond my facts, and I must be content to leave others to derive what indications they can from the data I have set forth.]

Previous classification —towns and country districts.

Note.—In a previous examination into this subject some years ago, the results of which were never published, I compared the geographical distribution of diphtheria, scarlet fever, and diarrhœa for the ten years 1861–70. The registration districts were divided into "dense towns," "open towns," and "country," in a somewhat different manner to that adopted in this paper, viz.:—

Districts with 10 persons and upwards to an acre were called *Dense Town Districts.*

Districts with one-tenth of an acre, but less than two acres to each person, were called *Open Town Districts.*

Districts with two acres and upwards to each person were called *Country Districts.*

The death-rates from each disease were compared, not with the death-rate from that disease in England and Wales, but with the death-rate in the same registration division.

	Number of Districts.			
	Dense Town.	Open Town.	Country.	Total.
DIPHTHERIA.				
25 per cent. *below* mean of division and lower	15	84	116	215
Within 24 per cent. above or below mean	30	57	132	219
25 per cent. *above* mean of division and higher	5	28	155	188
	50	169	403	622
SCARLATINA.				
25 per cent. *below* mean of division and lower	3	26	210	239
Within 24 per cent. above or below mean	36	93	159	288
25 per cent. *above* mean of division and higher	11	50	34	95
	50	169	403	622
DIARRHŒA.				
25 per cent. *below* mean of division and lower	4	35	262	301
Within 24 per cent. above or below mean	22	88	121	231
25 per cent. *above* mean of division and higher	24	46	20	90
	50	169	403	622

These figures, which were derived from the *Supplement to the Registrar-General's 35th Annual Report*, and from Mr. Lowe's "*Return of the average annual proportion of deaths from specified causes, &c., &c., during* 1861–70," show clearly that in its relation to density of population fatal scarlatina holds a place midway between those of fatal diphtheria and fatal diarrhœa.

It is, of course, *possible* that diphtheria and scarlatina may be, as was once generally believed, two forms of one and the same disease, whereof the one form is more frequently developed under rural conditions, the other under urban; but it is doubtful whether anyone would now venture to maintain this position.

TABLE III.

DEATHS from DIPHTHERIA in ENGLAND and WALES, at GROUPS of AGES, MALES and FEMALES separately.

	All Ages.	First Five Years.					0–	5–	10–	15–	20–	25–	35–	45–	55–	65–	75–
		0–	1–	2–	3–	4–											
MALES.																	
1855-60 - -	9,844	1,076	1,236	1,072	1,086	984	5,454	2,530	860	358	174	149	124	71	59	41	24
1861-70 - -	18,467	2,124	2,635	2,185	2,208	1,795	10,947	4,265	1,219	591	315	364	239	197	182	107	41
1871-80 - -	13,815	1,153	1,670	1,561	1,729	1,636	7,769	3,730	942	326	302	244	216	165	129	73	19
Total - -	42,126	4,353	5,541	4,818	5,023	4,435	24,170	10,525	3,021	1,275	691	757	579	433	370	221	84
Percentage of the whole	100	—	—	—	—	—	57·4	25·0	10·2		4·8			2·6			
FEMALES.																	
1855-60 - -	10,879	790	1,104	1,123	1,236	1,163	5,416	3,100	1,237	407	171	223	135	84	51	37	18
1861-70 - -	20,987	1,596	2,531	2,430	2,421	2,225	11,203	5,660	1,863	627	418	469	284	207	143	80	33
1871-80 - -	15,611	912	1,456	1,621	2,005	1,807	7,801	4,773	1,364	448	249	352	265	182	123	77	27
Total - -	47,477	3,298	5,091	5,174	5,662	5,195	24,420	13,533	4,464	1,482	838	1,044	684	423	317	194	78
Percentage of the whole	100						51·4	28·5	12·5		5·4			2·1			
Excess of female over male deaths - -	5,351	—	—	—	—	—	250	3,008	1,443	207	147	287	105	−10	−53	−27	−6
														Excess of Male Deaths.			

TABLE IV.

AVERAGE ANNUAL DEATH-RATES from DIPHTHERIA in ENGLAND and WALES PER MILLION PERSONS LIVING at several GROUPS of AGES, MALES and FEMALES separately.

	All Ages.	First Five Years.					0–	5–	10–	15–	20–	25–	35–	45–	55–	65–	75–
		0–	1–	2–	3–	4–											
MALES.																	
1855-60 - -	177	—	—	—	—	—	718	380	142	65	35	18	20	15	18	23	35
1861-70 - -	177	661	925	760	794	655	757	338	107	58	35	24	29	22	30	32	32
1871-80 - -	116	320	523	474	539	523	472	256	72	28	20	14	16	17	19	20	13
Average - -	157	490	724	617	667	589	649	325	107	50	30	19	19	18	22	25	27
							649	221		27							
FEMALES.																	
1855-60 - -	187	—	—	—	—	—	717	467	207	73	32	25	20	17	15	18	20
1861-70 - -	191	500	892	845	870	818	778	448	166	61	41	28	22	21	22	21	20
1871-80 - -	125	254	455	491	621	570	473	325	105	38	22	19	19	12	16	18	15
Average - -	168	377	673	668	746	694	656	413	159	57	32	24	20	17	18	19	18
							656	293									

TABLE V.

Registration Divisions of England and Wales arranged in the Order of their Diphtheria Death-rates per Million Persons living.

1st Period, 1855-60.		2nd Period, 1861-70.		3rd Period, 1871-80.	
North-Western	102	South-Western	119	York	95
South Midland	127	Northern	164	North Midland	98
London	130	South Midland	171	South-Western	103
Northern	155	North-Western	172	Northern	104
South-Western	165	London	176	South Midland	109
Welsh	167	York	180	Eastern	113
England and Wales	*182*	*England and Wales*	*184*	*England and Wales*	*121*
West Midland	202	West Midland	195	London	122
York	220	South-Eastern	200	North-Western	125
Eastern	230	North Midland	202	West Midland	141
South-Eastern	250	Welsh	204	South-Eastern	143
North Midland	348	Eastern	296	Welsh	163

TABLE VI.

Registration Divisions of England and Wales arranged in Order of (1) Diphtheria Death-rates, (2) Density of Population, and (3) Death-rates from all Causes. Average of 26 years 1855–80.

(1.) Diphtheria Death-rates. (England = 100.)		(2.) Density of Population. (Acres to 1 person living.)		(3.) Death-rates from all Causes. (England = 100.)	
		Welsh	3·79	South-Eastern	85
		Northern	2·81	South-Western	90
South-Western	80	South-Western	2·70	South Midland	90
North-Western	82	Eastern	2·67	Eastern	90
South Midland	84	North Midland	2·59	North Midland	94
Northern	87	South Midland	2·33	Welsh	97
London	88	South-Eastern	2·02	West Midland	99
England and Wales	*100*	*England and Wales*	*1·74*	*England and Wales*	*100*
York	102	York	1·67	Northern	103
Welsh	110	West Midland	1·52	Yorkshire	105
West Midland	110	North-Western	0·63	London	106
South-Eastern	122	London	0·02	North-Western	115
Eastern	131				
North Midland	133				

TABLE VII.

REGISTRATION COUNTIES arranged in the Order of their DIPHTHERIA DEATH-RATES, in each of Three Periods; the Rate for England and Wales being taken as 100.

1st Period, 1855–60.		2nd Period, 1861–70.		3rd Period, 1871–80.	
		Somerset	51		
		Buckingham	52		
		Hertford	63		
		Cornwall	63		
Lancashire	48	Monmouth	65	Buckingham	49
North Wales	49	Wiltshire	67	Northampton	56
Bedford	50	Glamorgan	68	Nottingham	61
Northumberland	60	Devon	70	Derby	67
Buckingham	63	Leicester and Rutland	70	Wiltshire	69
Oxford	66	Durham	72	Gloucester	73
Somerset	67	Extra-Met. Middlesex	74	West York	73
Metropolitan Middlesex	69	Oxford	76	Somerset	74
Hertford	69	Gloucester	77	Cambridge and Hunts	75
Northampton	71	Berkshire	79	Durham	75
Devon	74	Hereford	80	Norfolk	79
Metropolitan Kent	75	Bedford	81	Hertford	80
Cambridge and Hunts	76	Hampshire	84	Leicester and Rutland	82
Lake District	78	Dorset	84	Suffolk	83
Glamorgan	81	Derby	84	Dorset	84
Metropolitan Surrey	82	Worcester	85	Devon	86
Hampshire	83	Lancashire	87	East York	92
Extra-Metropol. Middlesex	86	Nottingham	89	Hampshire	93
Suffolk	86	West York	89	Stafford	94
Leicester and Rutland	89	Metropolitan Surrey	90	Metropolitan Middlesex	95
Gloucester	90	Metropolitan Middlesex	95	Berkshire	95
Cheshire	90	Stafford	95	Lancashire	95
Warwick	92	Lake District	96	Lake District	98
West York	94	Northampton	97	North York	99
England and Wales	*100*	*England and Wales*	*100*	*England and Wales*	*100*
Cornwall	102	Extra-Met. Surrey	104	Glamorgan	101
Worcester	111	Northumberland	113	Oxford	107
Durham	111	Extra-Met. Kent	114	Northumberland	107
Monmouth	111	Metropolitan Kent	119	Lincoln	110
Stafford	113	Essex	119	Metropolitan Surrey	112
Essex	117	East York	123	Essex	112
Extra-Metropol. Surrey	121	South Wales	124	Cornwall	112
Berkshire	123	Shropshire	126	Metropolitan Kent	119
Wiltshire	123	Cheshire	128	Hereford	121
Dorset	131	North York	132	Extra-Met. Kent	122
South Wales	138	Suffolk	138	Monmouth	122
Nottingham	139	Warwick	151	Extra-Met. Middlesex	124
Extra-Metropol. Kent	147	Sussex	152	Worcester	124
Shropshire	149	North Wales	155	Extra-Met. Surrey	131
Norfolk	165	Cambridge and Hunts	173	Bedford	132
Derby	165	Lincoln	173	Sussex	140
Hereford	183	Norfolk	219	Cheshire	140
East York	186			South Wales	145
Sussex	208			Shropshire	157
North York	232			Warwick	160
Lincoln	310			North Wales	168

TABLE VIII.

REGISTRATION COUNTIES of ENGLAND and WALES arranged in order of (1) DIPHTHERIA DEATH-RATES, (2) DENSITY OF POPULATION, and (3) DEATHS FROM ALL CAUSES.

(1) Diphtheria Death-Rates (England = 100) 26 Years.		(2) Density of Population (Acres to 1 Person living) 30 Years.		(3) Death-Rates from All Causes (England = 100)* 30 Years.	
				Extra-Metrop. Surrey	81
				Sussex	84
				Dorset	85
		South Wales	5·82	Hertford	86
		North York	5·35	Lincoln	87
		Lake District	4·67	Essex	87
		North Wales	4·61	Hampshire	88
		Hereford	4·14	Extra-Metrop. Kent	89
Buckingham†	54	Lincoln	4·12	Berkshire	89
Somerset	62	Northumberland	3·56	Extra-Metrop. Middlesex	89
Hertford	70	Shropshire	3·54	Wiltshire	89
Devon	76	Dorset	3·33	Hereford	89
Northampton	78	Wiltshire	3·24	Suffolk	90
Leicester and Rutland	78	Cambridge and Hunts	3·16	Shropshire	90
Gloucester	79	Norfolk	3·03	Worcester	90
Lancashire	79	Devon	2·76	North York	90
Oxford	82	Oxford	2·75	Somerset	90
Wiltshire	82	Suffolk	2·71	Cambridge and Hunts	91
Durham	83	Buckingham	2·69	South Wales	91
Glamorgan	84	Northampton	2·63	Buckingham	91
West York	86	Berkshire	2·61	Devon	91
Hampshire	86	Cornwall	2·50	Oxford	92
Cornwall	87	East York	2 40	Cornwall	94
Bedford	88	Sussex	2·39	Northampton	94
Metropolitan Middlesex	88	Hertford	2·32	Bedford	94
Extra-Metrop. Middlesex	92	Essex	2·31	North Wales	94
Lake District	92	Somerset	2·26	Norfolk	94
Monmouth	94	Leicester and Rutland	2·23	Gloucester	94
Metropolitan Surrey	94	Hampshire	2·16	Lake District	95
Nottingham	94	Bedford	2·12	Metropolitan Kent	97
Berkshire	95	Monmouth	2·09	Derby	99
Dorset	97	Stafford	1·93	Leicester and Rutland	99
Northumberland	97	Derby	1·80	Nottingham	100
Stafford	99	Nottingham	1·74	Cheshire	100
England and Wales	100	**England and Wales**	1·74	**England and Wales**	100
Derby	101	Extra-Metrop. Kent	1·70	East York	101
Worcester	103	Glamorgan	1·68	Monmouth	102
Metropolitan Kent	107	Gloucester	1·53	Warwick	104
Suffolk	108	Extra-Metrop. Surrey	1·52	Northumberland	104
Extra-Metrop. Surrey	116	Worcester	1·39	Glamorgan	105
Essex	116	Cheshire	1·33	Durham	107
Cambridge and Hunts	119	Durham	1·25	Metropolitan Surrey	107
Hereford	119	West York	1·04	Stafford	108
Cheshire	122	Warwick	1·03	Metropolitan Middlesex	108
Extra-Metrop. Kent	125	Extra-Metrop. Middlesex	0·79	West York	110
East York	131	Lancashire	0·44	Lancashire	120
North Wales	131	Metropolitan Kent	0·11		
South Wales	136	Metropolitan Surrey	0·03		
Warwick	138	Metropolitan Middlesex	0·02		
Shropshire	141				
North York	149				
Sussex	163				
Norfolk	164				
Lincoln	191				

* These rates are the arithmetic means of rates for three decades given in Table I. Suppl. 45 Ann. Rep. Reg. Gen.

† The name of a county is printed in *italics* when its diphtheria death-rate was above (or below) the average of England and Wales in each of the three periods.

TABLE IX.

First Period, Six Years, 1855–60. Population and Diphtheria Death-rates in Dense, Medium, and Sparse Districts of Registration Counties.

	Population living in			Diphtheria Death-rates per Million.		
	Dense Districts (less than 1 Acre to each Person).	Medium Districts (1 Acre, but less than 2 Acres to each Person).	Sparse Districts (upwards of 2 Acres to each Person).	Dense Districts.	Medium Districts.	Sparse Districts.
Metropolitan Middlesex	1,888,208	—	—	1,421	—	—
Metropolitan Surrey	531,092	—	—	472	—	—
Metropolitan Kent	163,814	—	—	135	—	—
Extra-Metropol. Surrey	88,166	20,725	129,002	87	20	208
Extra-Metropol. Kent	112,209	192,889	210,049	78	378	370
Sussex	95,554	15,178	242,488	104	18	681
Hampshire	142,014	80,812	206,509	71	42	275
Berkshire	24,758	20,346	157,326	16	16	240
Extra-Metropol. Middlesex	98,223	70,743	—	82	76	—
Hertford	—	64,429	111,278	—	30	101
Buckingham	—	21,922	123,509	—	18	82
Oxford	20,105	16,478	134,157	1	6	116
Northampton	37,508	—	184,954	12	—	159
Bedford	—	27,899	107,243	—	4	69
Cambridge and Hunts	27,088	—	219,389	18	—	187
Essex	68,486	25,786	267,646	43	35	386
Suffolk	48,929	22,106	264,738	19	16	279
Norfolk	118,542	—	312,049	79	—	694
Wiltshire	27,008	11,041	200,448	29	3	288
Dorset	—	54,845	124,799	—	62	196
Devon	148,154	—	428,873	76	—	394
Cornwall	55,401	112,193	193,917	30	105	268
Somerset	69,091	149,567	244,167	32	108	198
Gloucester	232,685	50,984	147,856	194	54	173
Hereford	—	—	102,958	—	—	206
Shropshire	24,444	51,316	179,197	11	62	340
Stafford	479,265	22,691	198,087	488	30	346
Worcester	131,471	57,127	88,245	149	48	139
Warwick	316,202	75,546	128,498	338	49	131
Leicester and Rutland	64,417	67,962	131,281	30	88	139
Lincoln	—	—	402,190	—	—	1,358
Nottingham	95,720	99,474	113,888	105	113	251
Derby	47,366	134,023	95,895	77	327	95
Cheshire	92,284	282,654	70,718	41	276	120
Lancashire	2,058,416	39,690	135,082	1,082	14	69
West York	991,165	133,154	312,726	855	140	492
East York	102,116	57,146	103,731	104	106	323
North York	—	—	202,257	—	—	511
Durham	195,373	221,821	59,708	137	297	144
Northumberland	171,164	—	152,133	55	—	154
Lake District	—	43,189	250,008	—	18	232
Monmouth	—	92,301	94,753	—	87	139
Glamorgan	—	205,730	77,445	—	179	72
South Wales	—	—	370,414	—	—	558
North Wales	—	84,521	324,602	—	42	176
England and Wales	8,766,416	2,626,288	7,604,213	123	182	248
				Mean	182	

58158.

TABLE X.

SECOND PERIOD, 1861–70. POPULATION and DIPHTHERIA DEATH-RATES in Dense, Medium, and Sparse Districts of Registration Counties.

—	Population living in			Diphtheria Death-rates per Million.		
	Dense Districts (less than 1 Acre to each Person).	Medium Districts (1 Acre, but less than 2 Acres to each Person).	Sparse Districts (upwards of 2 Acres to each Person).	Dense Districts.	Medium Districts.	Sparse Districts.
Metropolitan Middlesex	2,158,691	—	—	175	—	—
Metropolitan Surrey	660,952	—	—	186	—	—
Metropolitan Kent	209,482	—	—	219	—	—
Extra Met. Surrey	133,842	74,824	116,632	130	175	265
Extra Met. Kent	202,822	231,059	153,318	137	202	317
Sussex	114,989	63,107	215,772	223	290	305
Hampshire	201,467	68,468	215,438	133	229	155
Berkshire	53,623	—	162,329	117	—	156
Extra Met. Middlesex	133,309	92,781	—	131	143	—
Hertford	—	71,732	114,306	—	113	118
Buckingham	—	23,641	127,461	—	72	100
Oxford	20,526	19,436	134,819	166	139	135
Northampton	45,952	11,674	182,031	207	111	177
Bedford	—	32,490	113,519	—	92	165
Cambridge and Hunts	28,220	—	217,189	142	—	342
Essex	104,311	28,977	277,005	151	214	245
Suffolk	54,483	27,707	259,130	171	217	275
Norfolk	127,307	—	301,739	187	—	495
Wiltshire	26,950	10,561	202,836	85	284	120
Dorset	—	60,290	125,307	—	168	148
Devon	164,322	63,632	369,736	95	101	148
Cornwall	55,338	113,327	192,937	103	101	126
Somerset	68,964	157,717	246,329	93	110	82
Gloucester	265,505	37,902	162,740	130	153	155
Hereford	—	—	107,726	—	—	147
Shropshire	26,517	54,912	182,277	166	122	275
Stafford	598,422	46,846	178,220	171	226	173
Worcester	159,824	60,233	95,558	160	164	150
Warwick	386,368	77,810	131,725	328	161	197
Leicester and Rutland	81,706	70,530	130,605	98	122	151
Lincoln	—	—	416,109	—	—	318
Nottingham	112,791	112,672	114,131	120	147	224
Derby	56,692	154,180	98,515	120	154	178
Cheshire	166,477	267,337	68,280	196	239	318
Lancashire	2,418,073	95,123	98,706	159	177	162
West York	1,261,343	121,058	309,689	152	122	231
East York	122,651	62,408	105,443	126	176	374
North York	—	—	222,963	—	—	243
Durham	289,945	313,795	38,426	122	140	156
Northumberland	207,355	—	157,481	132	—	309
Lake District	—	45,723	275,489	—	192	175
Monmouth	49,664	88,422	70,256	62	128	149
Glamorgan	157,932	108,647	99,447	144	112	113
South Wales	—	—	373,303	—	—	236
North Wales	—	93,021	335,479	—	275	288
England and Wales	**10,926,808**	**2,962,041**	**7,500,396**	**163**	**164**	**223**
				Mean	184	

TABLE XI.

THIRD PERIOD, 1871–80. POPULATION and DIPHTHERIA DEATH RATES in Dense, Medium, and Sparse Districts of Registration Counties.

——	Population living in			Diphtheria Death-rates per Million.		
	Dense Districts (less than 1 Acre to each Person).	Medium Districts (1 Acre, but less than 2 Acres to each Person).	Sparse Districts (upwards of 2 Acres to each Person).	Dense Districts.	Medium Districts.	Sparse Districts.
Metropolitan Middlesex	2,418,569	—	—	115	—	—
Metropolitan Surrey	861,340	—	—	135	—	—
Metropolitan Kent	255,472	—	—	144	—	—
Extra-Met. Surrey	197,895	168,930	46,342	175	139	155
Extra-Met. Kent	314,190	238,357	116,280	143	149	162
Sussex	145,823	85,999	225,730	121	186	198
Hampshire	230,180	101,230	219,867	104	148	104
Berkshire	67,775	15,909	153,845	103	138	118
Extra-Met. Middlesex	274,303	48,531	—	166	58	—
Hertford	—	80,689	117,804	—	92	101
Buckingham	—	26,324	129,114	—	91	52
Oxford	21,459	24,820	133,285	228	193	101
Northampton	57,493	44,944	160,197	42	60	80
Bedford	—	36,884	116,015	—	103	178
Cambridge and Hunts	32,720	—	214,489	52	—	97
Essex	177,410	34,020	285,144	101	109	159
Suffolk	62,100	35,421	252,857	118	116	95
Norfolk	138,441	—	295,733	85	—	102
Wiltshire	27,295	41,470	177,337	59	51	94
Dorset	—	48,303	138,683	—	118	97
Devon	171,102	71,599	364,550	139	70	94
Cornwall	49,815	110,458	182,092	143	100	154
Somerset	130,746	112,037	243,844	77	80	102
Gloucester	305,765	63,456	137,742	75	131	97
Hereford	—	—	119,257	—	—	147
Shropshire	28,861	54,673	182,908	104	132	221
Stafford	673,728	63,253	205,116	95	179	158
Worcester	228,263	30,458	100,922	138	141	178
Warwick	459,650	81,797	130,054	217	84	181
Leicester and Rutland	108,798	118,954	96,350	106	73	125
Lincoln	—	—	445,568	—	—	133
Nottingham	240,586	40,396	116,041	53	45	128
Derby	70,482	217,250	67,975	71	82	90
Cheshire	198,878	381,860	—	168	169	—
Lancashire	2,863,753	189,146	41,628	109	200	154
West York	1,599,649	187,520	238,916	84	110	105
East York	157,274	70,801	106,403	96	73	157
North York	43,090	—	240,515	67	—	130
Durham	497,020	—	38,937	92	90	90
Northumberland	245,117	—	165,249	90	—	191
Lake District	—	103,126	270,058	—	138	112
Monmouth	53,801	100,512	72,707	154	138	155
Glamorgan	274,809	72,707	114,576	155	69	77
South Wales	—	39,674	322,405	—	81	187
North Wales	—	96,978	351,960	—	287	180
England and Wales	**13,701,984**	**3,512,210**	**7,129,163**	**114**	**125**	**132**
				Mean		121

TABLE XII.

REGISTRATION DISTRICTS in which the DIPHTHERIA DEATH-RATE was *above* that of ENGLAND and WALES in each of the three Decennial Periods.

I. Always 50 °/₀ above.	II. Twice 50 °/₀ above.	III. Once 50 °/₀ above.	IV. Never 50 °/₀ above.
Tenterden.	Chertsey.	Reigate.	ISLINGTON.
Bridge.	Guildford.	Godstone.	Dorking.
Hailsham.	*Bromley.*†	Hollingbourne.	Camelford.
Ticehurst.	*Tunbridge.*	Eastbourne.	*Foleshill.*
East Grinstead.	Cranbrook.	*Chichester.*	
Horsham.	Faversham.	Wokingham.	(4 districts.)
Petworth.	Battle.	Lexden.	
Chelmsford.	Uckfield.	Docking.	
Smallburgh.	Cuckfield.	Sturminster.	
Ledbury.	*Steyning.*	Bridgnorth.	
Ross.	Midhurst.	Oswestry.	
Ellesmere.	Petersfield.	Cheadle.	
Wem.	Peterborough.	*Burton-on-Trent.*	
ASTON.*	Witham.	Bourn.	
Solihull.	Blything.	Worksop.	
Horncastle.	Depwade.	Great Ouseburn.	
Gainsborough.	Penkridge.	Hemsworth.	
Howden.	KINGS NORTON.	Tadcaster.	
Driffield.	Holbeach.	Bridlington.	
Cardigan.	Grantham.	Guisborough.	
Aberayron.	Caistor.	Montgomery.	
(21 districts.)	Glanford Brigg.		
	East Retford.	(21 districts.)	
	Selby.		
	Patrington.		
	Thirsk.		
	Bedale.		
	Morpeth.		
	Rothbury.		
	Haverfordwest.		
	Newcastle-in-Emlyn.		
	Lampeter.		
	Crickhowell.		
	Knighton.		
	(34 districts.)		

* Dense districts are printed in SMALL CAPITALS. † Medium districts in *italics*.

TABLE XIII.

REGISTRATION DISTRICTS in which the DIPHTHERIA DEATH-RATE was *below* that of ENGLAND and WALES in each of the three Decennial Periods.

I. Never 50 °/₀ below.	II. Once 50 °/₀ below.	III. Twice 50 °/₀ below.	IV. Always 50 °/₀ below.
ST. GEORGE, HANOVER SQUARE.	WESTMINSTER.	*Farnham.*	SOUTHAMPTON.
ST. GILES.	WHITECHAPEL.	Hoo.	*Uxbridge.*
BETHNAL GREEN.	MILE END.	Fordingbridge.	Newport Pagnell.
ST. GEORGE-IN-THE-EAST.	THANET.	Andover.	Chard.
POPLAR.	Fareham.	Ware.	*Yeovil.*
Ringwood.	Basingstoke.	Royston.	Wells.
Wallingford.	Faringdon.	Hitchin.	BATH.
READING.	Wycombe.	*St. Albans.*	Blaby.
BRENTFORD.	Aylesbury.	*Hemel Hempstead.*	WIGAN.
Eton.	Henley.	*Berkhampstead.*	BOLTON.
WEST HAM.	Brackley.	Amersham.	HALIFAX.
YARMOUTH.	Hardingstone.	Buckingham.	Machynlleth.
Honiton.	Kettering.	Bicester.	
EXETER.	Woburn.	Brixworth.	(13 districts.)
Newton Abbot.	CAMBRIDGE.	Wellingborough.	
Totnes.	Woodbridge.	Oundle.	
Taunton.	Calne.	*Luton.*	
CLIFTON.	Westbury.	Halstead.	
Stroud.	Sherborne.	Sudbury.	
CHELTENHAM.	Dorchester.	BURY ST. EDMUNDS.	
Tewkesbury.	*Bridport.*	Devizes.	
Stone.	Crediton.	*Bradford-on-Avon.*	
WEST BROMWICH.	*Penzance.*	SALISBURY.	
DUDLEY.	*Scilly Islands.*	STOKE DAMEREL.	
STOURBRIDGE.	Bridgwater.	Helston.	
Stamford.	*Bedminster.*	Langport.	
Macclesfield.	Westbury-on-Severn.	Frome.	
HULL.	Cirencester.	*Keynsham.*	
Glendale.	SHREWSBURY.	Chipping Sodbury.	
Pontypool.	WORCESTER.	Thornbury.	
	Warwick.	*Nuneaton.*	
(29 districts.)	LEICESTER.	*Hinkley.*	
	RADFORD.	LEIGH.	
	LIVERPOOL.	ASHTON-UNDER-LYNE.	
	BURY (Lancashire).	BLACKBURN.	
	BARTON-UPON-IRWELL.	Settle.	
	MANCHESTER.	Skipton.	
	OLDHAM.	KEIGHLEY.	
	ROCHDALE.	*Todmorden.*	
	BURNLEY.	SADDLEWORTH.	
	Lancaster.	HOUGHTON-LE-SPRING.	
	Ripon.	*Chester-le-Street.*	
	BRADFORD.	GATESHEAD.	
	LEEDS.	Cockermouth.	
	Durham.	Llanelly.	
	NEWCASTLE-ON-TYNE.	Pembroke.	
	TYNEMOUTH.		
	Rhayader.	(46 districts.)	
	Pontypridd.		
	Neath.		
	Carmarthen.		
	Bangor.		
	(52 districts.)		

N.B.—Medium districts in *italics*; dense districts in SMALL CAPITALS.

TABLE XIV.

REGISTRATION DISTRICTS in which the DIPHTHERIA DEATH-RATE was in each of the Three Periods ABOVE that of the County in which they are situated.

I. Always 50 °/₀ above.	II. Twice 50 °/₀ above.	III. Once 50 °/₀ above.	IV. Never 50 °/₀ above.
Tenterden.	Petersfield.	HAMPSTEAD.	KENSINGTON.
Peterborough.	Woodstock.	ISLINGTON.	ST. PANCRAS.
Chelmsford.	Witham.	Bridge.	GREENWICH.
Sturminster.	Blything.	Faversham.	Cranbrook.
Axbridge.	Smallburgh.	Hailsham.	East Grinstead.
Ellesmere.	Mere.	Romsey.	Marlborough.
Horncastle.	Tavistock.	Wokingham.	Stafford.
PRESCOT.	Launceston.	*Hendon.*	Caistor.
Howden.	Northleach.	Aylsham.	Southwell.
Driffield.	Stow-on-the-Wold.	Blandford.	Bridlington.
Rothbury.	Penkridge.	*Poole.*	Thirsk.
Haverfordwest.	Market Harborough.	Camelford.	Guisborough.
Aberayron.	Gainsborough.	Williton.	(12 districts.)
(13 districts.)	East Retford.	*Clutton.*	
	Worksop.	Ledbury.	
	Newark.	Cheadle.	
	Runcorn.	*Burton-on-Trent.*	
	WEST DERBY.	KINGS NORTON.	
	Great Ouseburn.	ASTON.	
	Hemsworth.	Solihull.	
	Wortley.	*Ormskirk.*	
	Doncaster.	*Pontefract.*	
	Selby.	ECCLESALL BIERLOW.	
	Tadcaster.	*Cardiff.*	
	Patrington.	Cardigan.	
	Morpeth.	Knighton.	
	Lampeter.	St. Asaph.	
	Crickhowell.	(27 districts.)	
	Presteigne.		
	Ruthin.		
	(30 districts.)		

N.B.—Medium districts in *italics*; dense districts in SMALL CAPITALS.

TABLE XV.

REGISTRATION DISTRICTS in which the DIPHTHERIA DEATH-RATE in each of the Three Periods was BELOW that of the County in which they are situated

I. Never 50 °/₀ below.	II. Once 50 °/₀ below.	III. Twice 50 °/₀ below.	IV. Always 50 °/₀ below.
WESTMINSTER.	WHITECHAPEL.	*Farnham.*	Hoo.
ST. GILES.	RICHMOND.	MEDWAY.	SOUTHAMPTON.
BETHNAL GREEN.	GRAVESEND.	Fordingbridge.	Bicester.
MILE END.	THANET.	Andover.	Halstead.
POPLAR.	BRIGHTON.	*Uxbridge.*	*Nuneaton.*
KINGSTON.	Fareham.	*St. Albans.*	BOLTON.
Rye.	Basingstoke.	Amersham.	Machynlleth.
Eastbourne.	Faringdon.	Chipping Norton.	
Ringwood.	READING.	Brixworth.	(7 districts.)
Hungerford.	BRENTFORD.	CAMBRIDGE.	
Kettering.	*Berkhampstead.*	YARMOUTH.	
WEST HAM.	Newport Pagnell.	Thetford.	
Epping.	Brackley.	Helston.	
Tendring.	Wellingborough.	Chard.	
Sudbury.	*Luton.*	*Yeovil.*	
Henstead.	Dunmow.	SHREWSBURY.	
Calne.	BURY ST. EDMUNDS.	Atherstone.	
EXETER.	Stow (Suffolk).	*Warwick.*	
STOKE DAMEREL.	Woodbridge.	Blaby.	
Keynsham.	NORWICH.	STOCKPORT.	
CLIFTON.	KING'S LYNN.	WIGAN.	
DUDLEY.	Swaffham.	LEIGH.	
STOURBRIDGE.	SALISBURY.	Settle.	
Boston.	Shaftesbury.	KEIGHLEY.	
Lincoln.	Sherborne.	HALIFAX.	
DERBY.	*Penzance.*	HOUGHTON-LE-SPRING.	
BURY (Lancashire).	Frome.	*Chester-le-Street.*	
BARTON-UPON-IRWELL.	Thornbury.	Cockermouth.	
Lancaster.	*Madeley.*	Llanelly.	
York.	*Wellington* (Salop).	Pembroke.	
Durham.	Newport (Salop).	Bangor.	
TYNEMOUTH.	WORCESTER.		
	Stratford-on-Avon.	(31 districts.)	
(32 districts.)	*Hinkley.*		
	Stamford.		
	Mansfield.		
	NOTTINGHAM.		
	Ashton-under-Lyne.		
	Burnley.		
	Skipton.		
	SADDLEWORTH.		
	LEEDS.		
	HULL.		
	GATESHEAD.		
	NEWCASTLE-ON-TYNE.		
	Neath.		
	Rhayder.		
	Newtown.		
	Dolgelly.		
	Carnarvon.		
	(50 districts.)		

N.B.—Medium districts in *italics*; dense districts in SMALL CAPITALS.

LONDON: Printed by EYRE and SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.